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Professor Artemieff, of Russia, has invented an armor for protecting electricians or others who find it necessary to work in the vicinity of high-pressure lines. This armor consists of a complete suit of woven wire gauze which the wire man dons when he goes to work.

Professor Artemieff's idea is good, theoretically, but it can hardly have much practical value. A pair of rubber gloves can be put on more easily, while the usual method of not providing any protection whatever is even less troublesome. Moreover, the life of this armor would not be long, and there are few wire men who will tolerate the irritation produced on the cuticle by but one or two broken ends of wire. Why not make this armor of spun glass cloth?

COLONEL JOHN JACOB ASTOR'S GIFT TO THE PUBLIC.

Colonel John Jacob Astor, in a letter to the *Scientific American,* dedicates all his patents on marine turbines to the public, in the hope that the development of this idea may bring the steam turbine to a high state of perfection.

Colonel Astor's turbine consists of a funnel-shaped outer shell or drum, having on its inner surface spirally arranged blades. Within this there is a solid axle carrying spiral blades set in the opposite direction. Both parts of the turbine revolve in opposite directions, and each drives a screw at the stern of the boat. By allowing the inner turbine and the outer case both to revolve, the speed necessary to ensure efficiency is cut in half.

The following advantages are claimed for this type of turbine: As both parts revolve, the weight for a given output is reduced; the steam efficiency is high and mechanical friction is much reduced. It is suggested that this type of turbine is suitable for central station work, as the armature and field of the alternator can be driven in opposite directions. This would improve the efficiency of the dynamo and decrease the weight.

Colonel Astor's activity in public affairs is too well known to need comment. In the Spanish-American War he not only gave freely of his means, but he risked his life as well in the service of his country.

By surrendering his rights in this case, he not only gives further evidence of this liberal spirit, but by throwing the construction of steam turbines open to competition he thereby greatly stimulates developments in this important line of work. The gifts of the rich to the public are often belittled by the saying that they are merely giving back what they in the first place took away. It is worth noting that this ungenerous comment does not apply to the gift of this invention to the public.

THE ROWLAND PRINTING TELEGRAPH.

A description of the printing telegraph, invented by the late Professor Henry A. Rowland, will be found on another page of this issue. This apparatus represents the results of years of work of that remarkable and indefatigable genius.

In this system many beautiful physical principles are applied, through ingenious electrical and mechanical devices. The system belongs to the synchronous class of telegraphs—that is to say, it depends for its operation upon the exactly synchronous movement of parts at opposite ends of a transmitting line.

This synchronism is secured by using a small synchronous motor at the receiving end, which serves to overload or underload a direct-current motor which itself drives the receiving apparatus. An ingenious damping-wheel prevents hunting which might otherwise occur.

The transmission of signals is effected by an alternating current sent out over the line, and this serves at the same time to hold the receiving mechanism in synchronism with the alternator at the transmitting end. The alternating current passes through a small switch or key which is normally closed but which can be opened by an electromagnet.

A commutator containing fifty-two segments is connected to the transmitting keyboards. The latter do not differ materially from the keyboard of an ordinary typewriter. Eleven of the segments of this commutator are assigned to each keyboard. In depressing any key, two contacts are made at the board, which allow a current from a local circuit to pass to the commutator and out through a brush which is revolving synchronously with the sending apparatus and which rubs on the surface of the commutator. Since two contacts are made, two momentary impulses of current will pass out through this brush, and each acting for a moment on the transmitter, will draw

its armature away from the stop, and cut out in this way two half waves from the line current. Each character is represented by a certain combination of two half waves.

At the receiving end, this alternating current passes through the coil of a relay, and these constant pulsations act practically as a continuous current, holding the armature of the relay in one position against the attraction of a spring. At that instant, when one of the half waves which has been cut out would pass through the relay coil, this half wave being absent, the spring throws the relay armature over and closes a local circuit, and throws over the armature of a selecting relay. This operation is repeated when another half wave is lacking. The closing in this way of two local relays completes another local circuit through an electromagnet which, throwing up a small hammer, throws the recording paper against the printing type-wheel. This operation is effected through a commutator and revolving brush somewhat similar to that used in transmitting the signal. The type-wheel and brush are revolved synchronously by the driving motor, as explained above. By various combinations of half waves, the printing hammer can be thrown up at any instant, and thus cause any desired character to be reproduced upon the paper.

The fifty-two half waves are repeated four times per second. Thus each sending board can, if operated rapidly enough, send out four signals per second. As there are four sending keyboards, this allows sixteen signals per second to be sent out over the line in one direction. The system can be duplexed, making a total of 1,920 signals per minute. The system has been used successfully over a line of 550 miles, and it is thought that it would work perfectly without relaying over distances of 1,000 miles. Professor Rowland, however, devised a method for automatically relaying his messages, and thus making the possible distance of transmission much greater. An important feature of the system, which has been adhered to throughout, is the natural way in which it divides itself into distinct units. All of the keyboards are identical, and all the receiving apparatus is similar. Any breakdown of one receiving or transmitting set does not affect in any way the others, and by a simple method of uncoupling the defective part and replacing it with a new unit, the system is restored to its normal operating condition.

The system is kept in adjustment, as far as the main line is concerned, much more easily than other systems. Since an alternating current is employed, condensers may be used in series, and in this way prevent any harmful disturbance which might occur from earth currents or leakage from electric railways.

The messages as sent out are printed automatically in page form, and are ready for distribution. Moreover, each sending and receiving set is equipped with a small recording device which prints the message on a strip of tape.

The Rowland system has been adopted by the German Government, and is now being used in that country. If this system can be kept in operation without excessive attention and care, it will probably be widely adopted. The method of transmitting messages is so simple—requiring nothing but the operation of a typewriter keyboard—that any one can learn quickly to operate this. The apparatus, however, is more or less delicate, and the adjustments required to keep it in an effective operating condition can only be made by one familiar with the system and its appliances.

The gas engine seems to be slowly but surely making its way in generating stations. This type of engine has recently been installed in a number of factories, not only in connection with a blast furnace, where it can be used with the greatest economy, but even where an independent gas-producing plant was required.

A striking feature of some of the plants will be the operation in parallel of direct-connected gas engine driven alternators; these engines here performing the very work for which they were until recently supposed to be least suitable.

THE SHUNT MOTOR.

Electrical machines are looked upon by the lay observers as being wonderful and complicated mechanisms. Wonderful they certainly are, for no one as yet fully understands the physical reactions which the electrical engineer makes use of. But, accepting as we find them certain physical phenomena, the operation of many electrical machines is explained in an extremely simple way.

Not only is the explanation of the operation simple, but in many cases the desired end has been reached by eliminating all accessory apparatus and reducing the design of the machine to the simplest basis.

This is beautifully illustrated by the shunt motor. In the early days the possibilities of securing, by means of this machine, a constant speed were realized, but at that time the behavior of the machine was not perfectly understood, and special contrivances for controlling the speed were thought necessary. This followed the practice found necessary in other branches of engineering.

Careful experimental study of this type of machine soon showed that the desired end could be attained by a proper design of the machine itself, and that no governor whatever was necessary to secure a regulation in speed as close as that found satisfactory in mechanical engineering. Moreover, the type of machine which was found to give satisfactory speed regulation is that dictated by the considerations of a good design, both for reliability and efficiency.

Let us consider briefly the reactions which take place in a shunt motor which make this solution of the problem possible.

It need hardly be stated to-day that a shunt motor is in principle merely an inverted shunt dynamo. The shunt dynamo is a self-exciting machine, with the winding of the field magnet connected across the brushes. The armature is so wound that all of the wires lying on the surface are connected together, forming a closed loop.

This machine, as already stated, can be used as a shunt motor. Let it be con-

nected to a suitable source of electrical potential, and let us assume that it is running. The potential will cause a current to flow through the field windings of the motor and through the armature circuit, the former, of course, serving to excite the field. Its strength is determined by the potential across the field windings and the resistance of the circuit. The current flowing through the armature, however, depends upon another reaction. We have here an armature revolving in a magnetic field. When the machine is used as a dynamo, electromotive forces are set up in the wires on the armature. Will not the same reaction take place in the case of the motor? This is just what does happen, and each wire as it passes through the magnetic field has set up in it an electromotive force, and these are added together just as in the dynamo.

A fundamental law of physics states that reactions set up always oppose the action which causes them. In the case of the motor we have a difference of potential applied to the brushes. This causes the current to flow through the armature. The passage of the current through the armature causes the latter to revolve in the magnetic field, and its motion in the magnetic field sets up electromotive forces. Therefore, these electromotive forces must oppose the flow of current. But Ohm's law states that the current strength is determined by the difference of potential effective in setting up the current and by the resistance of the circuit. In this case we have an electromotive force applied at the brushes, and an opposing electromotive force set up in the armature, and the effective electromotive force will be only the difference between these two. The opposing electromotive force is termed the "counter" electromotive force, and the current passing through the armature can be calculated, if this be known, by deducting the counter-electromotive force from the impressed electromotive force and dividing by the resistance of the armature.

Faraday's law states that the electromotive force set up in a moving conductor is proportional to its speed and to the strength of the magnetic field. We see, then, that in our motor the counter-electromotive force will be proportional to the speed, as the field will be practically constant. If the speed be high enough, the counter-electromotive force will be equal to the applied, and no current will flow through the armature. Of course, the motor will not run alone under this condition, as energy must be furnished to supply the losses. If, therefore, power is not supplied in any other way, the speed of the motor will decrease from that just assumed, and with it the counter-electromotive force. This allows a current to flow through the armature. The greater the decrease in speed, the less the counter-electromotive force, and the greater the difference between this and the applied, and, consequently, the greater will be the current. The motor then runs at such a speed that the current passing through the armature develops just sufficient turning effort to keep the armature running at that speed, doing its work and supplying the losses. If additional load is thrown on the motor, this calls for a greater turning effort, and the motor will slow down until the increase in current is just sufficient to establish equilibrium.

We stated above that the current passing through the armature is determined by the difference between the applied and the counter-electromotive force, and by the resistance of the armature. If the armature resistance is small, a small difference between the electromotive forces will be sufficient to cause the necessary current for any conditions to flow, and it then follows that a motor having a low armature resistance will vary but slightly in speed no matter what the load.

The losses in a motor being made up of those due to the reversal of the magnetism in the iron and those due to the resistance of the circuits, it is evident that the latter loss will decrease with the decrease in the resistance of the armature; and this explains the point we made above, that that design of motor which gives a constant speed will be efficient. It should be stated here that we are not considering the losses in the iron.

It is undoubtedly true that much of the success of electrical machinery arises from the simple means used to attain the desired end, and the shunt motor is one of the prettiest examples of this.

TELEPHONE EXPANSION AND ECONOMICS.

The stationery of a telephone company bears the following declaration of principles on the subject of expansion, which can be endorsed by all good citizens, irrespective of politics:

EXPANSION.

It is the purpose of the management to extend the use of the telephone to every town, no matter how small, throughout its territory; and in all of the cities and towns, to put a telephone, at the most reasonable rates, within easy and immediate reach of every person whose income is sufficient to permit him to ride on street cars.

It has never been shown that the cost of electricity is any exception to the general principle that two apples can not cost less than one apple, and this fruit which has held so important a place in human affairs from the incident in the Garden of Eden to giving Sir Isaac Newton the hint for the hypothesis of gravitation may also be applied to the telephone rates of to-day.

It bears no good to anybody for a telephone company to attempt to furnish service at less than cost, and it is essential to both the telephone companies and the public that this service should be done at a price which is reasonable and fairly remunerative under conditions of good management.

Anything less than a remunerative price must detract from quality of the service and the condition of the apparatus, both of which are to the detriment of the telephone subscriber. Moreover such losses must ultimately impair the capital invested and if such a method of doing business extends beyond a certain degree insolvency results, followed by the refusal of capital to invest in enterprises which should contribute to the good of a community.

When telephone systems have operated a few years longer, there will be accumulated information as to the cost of the service, but there is nothing more deceiving to those new in the business than the expense caused by depreciation in the property and the necessity for renewals to keep pace with the march of invention.

The Rowland Writing Telegraph.

Day Allen Willey.

THE writing telegraph system invented by the late Professor Henry A. Rowland has been adopted for commercial purposes in Germany, and is now being tested with a view to its adoption in several other European countries. As is well known the system depends on the wave method, but the installation is comparatively simple. The principal mechanism consists of a transmitting keyboard, the automatic message receiver or page printer, a home recorder or message duplicator, a transmitter, a synchronizer, besides the necessary relays, alternators and connections.

Professor Rowland found that he could employ with advantage about 208 alternations of the current per second, and hence the fifty-two half waves employed will pass over the line in one-fourth of a second, that is, any group of waves will repeat itself four times each second.

The operation of transmitting the cut-out wave signals over the line is performed on an ordinary Remington keyboard. These keyboards are so constructed that the keys can only be depressed at intervals, corresponding to the passage of fifty-six waves over the line, that is, at intervals of about one-quarter second. The locking device which times the depression of the keys is called the "clapper" and unlocks the keys four times per second. Each of the four keyboards illustrated can only cut waves out of the group which is assigned to it. The manner in which this is done, and how the waves can be cut out near the point of zero current over the line, may be understood by a reference to the diagram.

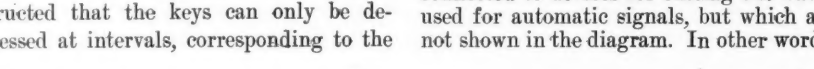


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF CIRCUIT, ROWLAND PRINTING TELEGRAPH.

In Fig. 1, K_1, K_2, K_3, K_4 represent the four keyboards. Each keyboard is supplied with eleven insulated contact springs, 1, 2, 3, etc. To the frame of each keyboard is attached the negative terminal of a direct-current 110-volt circuit. When any one of the forty-one keys belonging to a keyboard is depressed, contact is made with some two of the eleven contact springs. The contacts made will be the combination which corresponds to the letter marked on the key C, which is a so-called commutator or "sunflower." It is similar in construction to the commutator of a small dynamo and has fifty-two segments insulated from each other. There are four sets of segments, which are connected respectively to the eleven contact springs of the keyboards K_1, K_2, K_3, K_4. The remaining eight segments are some of them entirely insulated, while others are connected to devices for cutting out waves used for automatic signals, but which are not shown in the diagram. In other words, the segments are divided up so as to correspond with the groups of half-waves shown in Fig. 2. The group A is connected to the contact springs of keyboard K_1, the group B to the contact springs of keyboard K_2, etc. Corresponding to the half waves between the groups, A, B, C, etc., there are insulated segments which are shown in cross-section in the diagram. A brush or trailer, t, travels around the commutator, C, in synchronism with the dynamo, D_a, being geared to its shaft. This trailer passes from the centre of one segment to the centre of the next, while the current from the dynamo, D_a, makes half a wave. When the brush is at the middle point of a segment, the current from the dynamo is supposed to be passing through zero value.

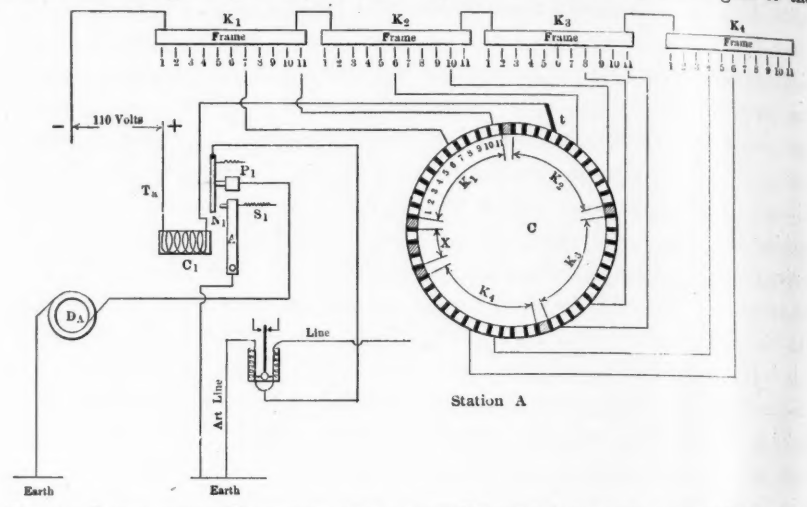
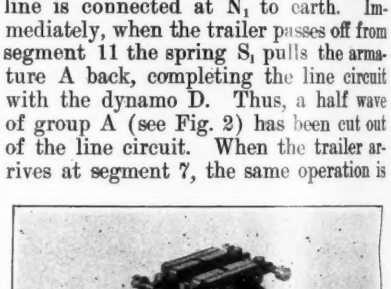


FIG. 1.—DIAGRAMMATIC REPRESENTATION OF THE SENDING APPARATUS OF THE ROWLAND WRITING TELEGRAPH.

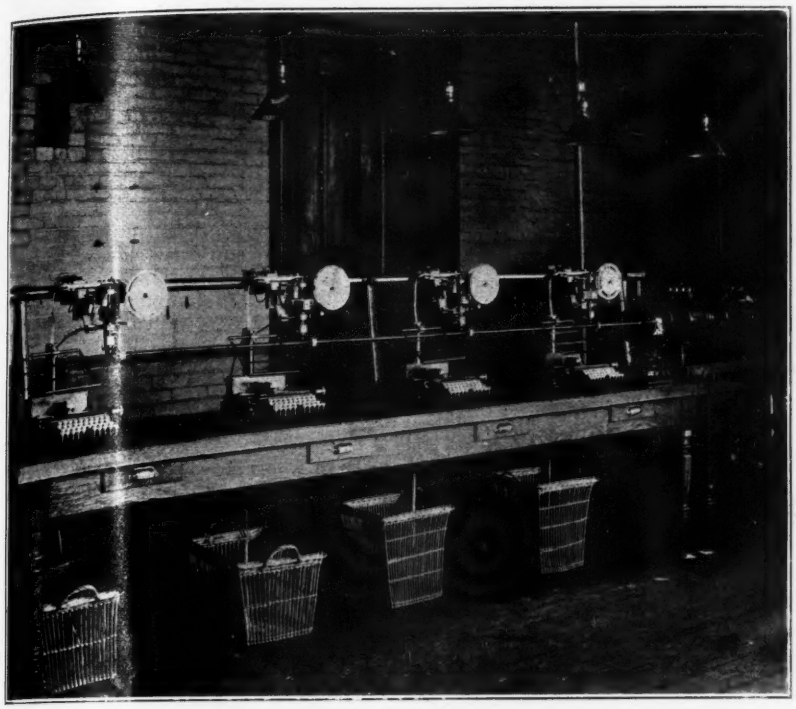
If a key be depressed on keyboard K_1, contact with the frame of this keyboard will be made with two of the contact springs, as, say, 7 and 11. When the trailer, sweeping around the commutator, reaches segment 11, which is connected to contact spring 11, the current from the 110-volt circuit flows momentarily from the positive pole through the coil C of transmitter T_a, to the trailer t, from there to the segment 11, thence to the contact spring 11, to the frame of the keyboard and back to the negative terminal. This current causes the transmitter T_a to draw back its armature A and thus break the dynamo circuit at P, which goes to the relay and line, and at the same time the line is connected at N_1 to earth. Immediately, when the trailer passes off from segment 11 the spring S_1 pulls the armature A back, completing the line circuit with the dynamo D. Thus, a half wave of group A (see Fig. 2) has been cut out of the line circuit. When the trailer arrives at segment 7, the same operation is repeated, because the contacts which are made at the keyboard continue for a period equal at least to the time that the trailer takes to pass over the eleven segments which are connected to that keyboard.



MAIN LINE RELAY, ROWLAND PRINTING TELEGRAPH.

In like manner the operators on keyboards K_2, K_3, K_4 can cut out, by depressing some one key, and two waves from the groups of eleven which belong to them. An insulated segment is placed between each two groups of eleven waves, so that, in case the last half wave of one group and the first half wave of another

group is cut out, there will be an interval of a half wave between these occurrences.



ANOTHER VIEW OF THE SENDING APPARATUS, THE ROWLAND PRINTING TELEGRAPH.

This is found to be necessary for the proper operation of the main line relay at the receiving station.

At the same time a message is being transmitted by the keyboard, a copy is being made on what is called the home recorder, which operates on the familiar principle of the "tape" of the stock quotation recorder; this can be utilized as a voucher for the accuracy of the operator and as evidence of the transmission of the message.

The method of receiving the wave signals is illustrated in Fig. 3, which shows diagrammatically the combination commutator, the tongues and contact points of one of the four banks of the "selecting" relays, and also a part of the connections of the page printer. The combination commutator is made up of three parts or circles, C_1, C_2, C_3. Each of these circles is divided into segments of different widths, with insulation between; t_1, t_2, t_3, are three brushes, or trailers, which sweep together around the commutator in the same time as the trailers on the sending and receiving commutators, and, being on the same shaft with the type-wheel, turn also with it. These trailers, as they come to bear upon different combinations of segments of the commutator, complete, together with contacts made by the relays of one of the four banks, circuits which actuate magnets that print the character and shift the paper. R^1_p is one of the four "distributing" polarized relays.

The current, through its coil *b*, brings its tongue against the back-stop S, and a current, through its coil *f*, brings its tongue against the contact point *k*. P is a small printing magnet, which, when energized, causes the hammer or platen, *h*, to strike the paper up against the rim of the revolving type-wheel. This is done so rapidly that the type-wheel may continue in constant rotation, although, being attached to the shaft by means of a spring, it may, momentarily, pause. X and Y are the positive and negative terminals of a 110-volt direct-current circuit. The spacer, liner and back magnet, and the distributing relays which actuate them, are, for the sake of clearness, not shown in the diagram.

A letter is now printed as follows: Two half waves having been cut out of a group of waves to which the bank of selecting relays R_a belongs, two of these relay tongues are thrown against their contact points, where they remain until a reverse impulse returns them to their back-stops. Suppose contact is made with the contact points *a* and *h*, then, after a certain time, the trailers t_1 and t_2 will have arrived on segments of the combination commutator, which are respectively connected to the contacts *a* and *h*, and the trailer t_3 will then be in this case on the segment S. It may be noted that the inside circle C_4 shows the position of the letters on the type-wheel corresponding to the combinations of segments on the combination commutator. The following circuits are now completed. The current starting from the positive pole X passes through the coil *f* of the "distributing" relay R_d, throwing its tongue against the contact *k*. Thence it passes to the segment S and out through the trailer t_3 and into the trailer t_2, thence into the seg

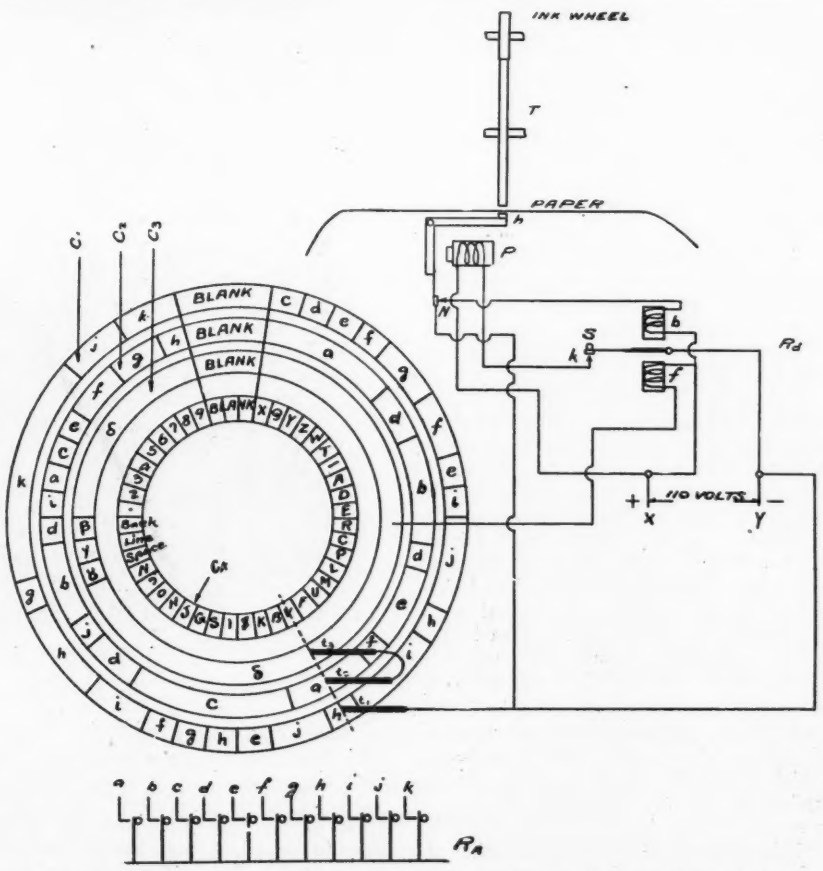
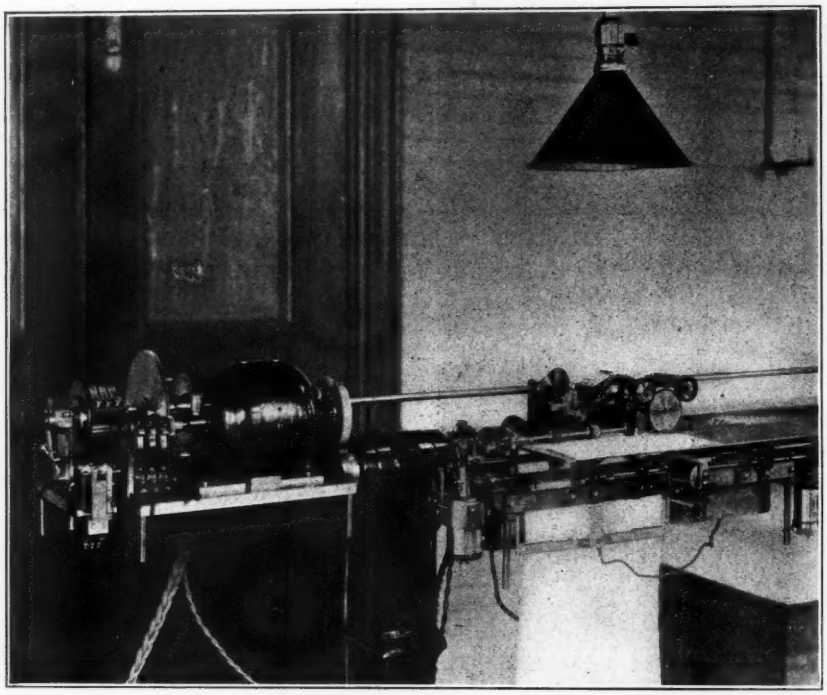


FIG. 3.—DIAGRAMMATIC REPRESENTATION OF THE RECEIVING APPARATUS, ROWLAND PRINTING TELEGRAPH.

ment *a* of the commutator connected to the contact point *a*. From there through the tongue of the relay and by the frame of the relays of the bank to the tongue, making contact with contact point *h*, thence to the segment connected to this contact point *h*, and thence by the trailer t_1 and its connection back to the nagative terminal Y. It may be stated, in passing, that all segments of the combination commutator are connected to the contact points of the same letter of the bank of relays R_a.



THE RECEIVING APPARATUS, ROWLAND PRINTING TELEGRAPH.

At the instant that the above occurs, the type-wheel, T, has turned into a position so that the letter engraved upon its rim, and which corresponds to the combination of segments *a-h* on the combination commutator, is just over the platen *h*. In this case the letter would be V. At the same time, contact being now made at *k*, a circuit is completed which makes the platen strike the paper up against the type-wheel, and so prints the letter. This circuit is from X through the coil of the printing magnet, P, to the contact *k* and back through the relay tongue to the negative pole. At the instant, or just before, the platen *h* strikes the paper against the type-wheel, a contact is completed at N which permits a momentary current to pass through the coil *b* of the relay R_d, thus returning its tongue to its back-stop.

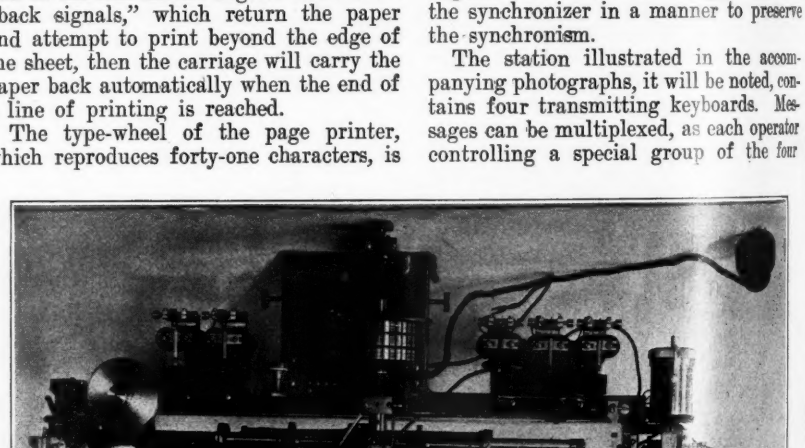
A further circuit, which is not here shown, is also automatically completed, which causes the paper to shift sideways under the wheel through the distance of a space between letters, that is, "spacing up" is automatically accomplished. In this manner thirty-eight characters may be printed. Three combinations as *g-b*, *k-b*, *k-d*, are reserved for spacing, lining and backing the paper at the will of the operator at the far end of the line. The segments *a*, *y*, *b* on the combination commutator are attached to coils of the polarized relays, not shown, which distribute current to magnets that perform the above function. If the operator at the other end of the line should neglect to send the "back signals," which return the paper and attempt to print beyond the edge of the sheet, then the carriage will carry the paper back automatically when the end of a line of printing is reached.

The type-wheel of the page printer, which reproduces forty-one characters, is of steel, being two inches in diameter. The other essential features of the printer comprise a carriage for the paper, devices for moving the paper to space the lines and letters, the printing magnet already described and the polarized or distributing relays. These are in sets of four, serving not only to time the contact of the paper with the type-wheel, but to control the movements of the paper.

To establish the synchronism so essential in operating the system the inventor devised a mechanical "damper," which is one of its most interesting as well as its most remarkable features, eliminating the "pumping" which would otherwise occur. Fixed to the shaft S of a single-phase alternating-current motor of small size is an aluminum wheel, in which is cut a small channel filled with mercury. If the speed of the rapidly revolving shaft and its wheel be subjected to oscillating increases and decreases, the mercury, on the other hand, will tend by its inertia to revolve at a uniform velocity. A friction is produced between the mercury and the walls of the aluminum channel when their speeds are unlike. The oscillation or "pumping" is thereby dampened, and the rotation of the shaft becomes smooth and uniform. The device is simple but effective.

The synchronizer itself consists of a small alternating, single-phase, four-pole motor of special design. The armature is made of four flat coils without iron, and has a diameter of about three inches. Synchronism is maintained by local currents. The line current, of from thirty to seventy milliamperes, has only one function to perform, and that is to keep the two tongues of the polarized relay in constant vibration. In a novel method of making contacts one of these tongues is made to complete the local circuits which print the characters, while the other tongue serves to send positive and negative local currents through the coil of the synchronizer in a manner to preserve the synchronism.

The station illustrated in the accompanying photographs, it will be noted, contains four transmitting keyboards. Messages can be multiplexed, as each operator controlling a special group of the four into which the fifty-six waves are divided can send a signal every quarter second, the total capacity of the station being 960 signals in one direction every minute. The average speed of a service of eight operators is 320 words with the Rowland system. At present the maximum distance of transmission is about 550 miles, but it is expected to serve lines a thousand miles and over in length when certain improvements being made to the apparatus are completed.



ANOTHER VIEW OF THE RECEIVING APPARATUS, ROWLAND PRINTING TELEGRAPH.

A Recent Advance in Electric Lighting.

A Study of the Nernst Lamp.

THE exceedingly poor efficiency of all of our illuminants has caused many inventors to endeavor to discover some improved method of lighting. Probably the most important in this direction in recent years is that due to Dr. Walther Nernst. It is well known that certain non-conductors at ordinary temperatures become conductors when heated, and if raised to a sufficiently high temperature will become very highly incandescent.

Dr. Nernst, the inventor of this new type of incandescent lamp, was born in eastern Prussia. His early life was passed in the neighborhood of his birthplace, and did not differ from that of other German boys. His student work was done partly at Gratz, in Austria, where he was thoroughly prepared for later work. The first scientific work of distinction accredited to Dr. Nernst is embodied in his investigations with von Ettinghausen, this being a very complete study of a certain phenomenon analogous to the Hall effect. After this, he was associated with Ostwald and Arrhenius, at Leipsic, and was one of the founders of the famous dissociation theory which has done so much for physical chemistry.

Dr. Nernst was then called to Goettingen as an assistant professor, and before long was raised to the first chair of physical chemistry ever founded, and was made director of the new institute established for the study and advancement of this science. This laboratory was especially equipped for his research work. While at Goettingen he refused a number of flattering offers, one of these being from Berlin. His work at Goettingen in developing the German school of physical chemistry is well known.

One of the problems submitted to Dr. Nernst was that of determining the high light efficiency of the Welsbach mantle. In order to eliminate chemical action he attempted to raise the temperature of a rod formed of these rare earths to a high temperature, and study it while in this condition. His method consisted in placing the rod between the poles of an induction coil and causing a discharge to pass through it. It was noticed here that the discharge took place more readily through the material than over the surface. This phenomenon had previously been observed by Jablochkoff with plates of kaolin, but this fact was not known to Dr. Nernst at the time of these experiments. This effect of conducting the discharges was attributed by Dr. Nernst to the temperature of the rod, and to prove that the rod became a conductor at high temperatures it was heated externally, and his deduction was found to be good.

The next work carried out along this line was the substitution of a one-quarter-horse-power rotary converter for an induction coil in 1897. The only source of current at the university was direct,

DR. WALTHER NERNST.

and a rotary converter was used to convert this to alternating current, giving about 200 volts at no load. This small machine had a peculiar characteristic. The armature reactions were great, so that the machine became very nearly a constant-current converter. This accidental feature of the work is claimed by Mr. H. Noel Potter to have probably been the means of showing that the Nernst lamp could be made a commercial success.

As is well known, the Nernst filament has a negative temperature coefficient, and had it not been for this characteristic of the rotary, the filament would undoubtedly have flashed out very quickly after being brought to incandescence, and this discouraging result might have caused the abandonment of the work.

In 1898 Dr. Nernst's work was brought to the attention of Mr. George Westinghouse by Mr. Potter. Mr. Westinghouse quickly recognized the value of the work, and secured the patent rights for America. The firm of Ganz & Company, of Budapest, hold the patent rights for Hungary and the Balkan states, and the rest of Europe is controlled by the Allegemeine Elektricitäts Gesellschaft. The remaining portions of the civilized world are controlled by the Nernst Lamp Company, of London.

The first development on a commercial scale was carried out by the Allegemeine Elektricitäts Gesellschaft, but it probably attempted to introduce the lamp before it had been sufficiently perfected, and its unsatisfactory performance at that time has seriously retarded its introduction in a more perfected condition in Europe. The work there was carried out almost entirely with direct currents, although there seems to be no advantage in this system, and there are some decided disadvantages.

The development of the lamp in this country is due to Mr. A. J. Wurts, with whom were associated Mr. Potter, Mr. M. W. Hanks and others. It was decided to develop but one standard filament—or glower as this is called—and to vary the power of the lamps by using as many of these as might be necessary. This method of work enabled the efforts to be concentrated upon determining the proper method of manufacturing, maintaining and operating a single glower. Another point recognized in the development of the lamp was that the useful candle-power of any illuminant is only that which is emitted by the lower hemisphere, unless suitable reflectors are supplied. No attempt, therefore, was made to secure an upward diffusion of light.

The Nernst lamp contains three primary elements—the glower, the ballast or regulating resistance, and the heater. The glower is made by pressing through a die a dough formed of the oxides of rare earths, mixed with a suitable binding material. The porcelain-like thread thus obtained is then cut into convenient lengths, dried and roasted, and finally attached to the leading-in wires.

In Dr. Nernst's type of lamp, connection was made to the glower by twisting a platinum wire several times around the ends. In attempting this form of connection, it was found that the glower

would shrink and draw away from the platinum, and that a satisfactory joint could not be maintained. This introduced a serious problem, which was very prettily solved by Mr. Hanks. A glower somewhat longer than will be used in the lamp is taken, and one end held in a lagging electric arc, an excessively high temperature not being desirable. The tip of the material fuses and draws it into a small globule. This is then drawn out of the arc, and by means of an oxyhydrogen flame, a small particle of platinum is deposited upon this globule, and the end of the glower is again inserted in the arc. The material fuses as before, as does also the platinum; but the surface tensions of the two materials being different, the small globule of platinum formed is slowly drawn into the larger ball of molten glower material. This drawing-in of the platinum takes place slowly and can be stopped at any stage by removing the glower from the arc. Since the platinum is more fusible than the glower material, it is a simple matter to weld a small platinum wire to the globule of platinum which is almost entirely enclosed in the glower material. This joint has the excellent property of gripping the platinum more firmly as the glower material shrinks.

The adjustment of the glower for the proper voltage is also performed very prettily. The material is so carefully prepared that the exact length needed for a particular voltage can be accurately laid off. The strip into which the platinum terminals are introduced is rather longer than that required in the lamp. To adjust this to the proper length it is only necessary to hold it in the arc, and as the oxides melt the material collects into globular form and slowly creeps up the cylindrical portion of the glower. When the latter has been brought to the desired length, the glower is removed from the arc, and is then exactly adjusted for use. This work, of course, can not be watched directly, as the temperature is very high and the materials very bright. An image of the glower is therefore thrown, by means of a lens, upon a screen, and the whole operation watched there. This enables a very accurate adjustment of the length of the glower to be made, the glower being held in horizontal wheel which fixes definitely the upper terminal. When the image of the lower globule has crept up to a mark on the screen, the wheel is turned and removes the glower from the arc.

This operation shows very prettily the relative efficiencies of platinum and these rarer oxides. The image of the globules on the screen shows a dark centre for the platinum and a bright surrounding portion for the oxides, although these materials must both be at the same temperature. It was found experimentally that the efficiency of the glower was not improved by enclosing it in an exhausted globe. The effect of this so altered the characteristics of the glower as to require more ballast without a compensating increase in the luminous output. The effects of inert gases introduced into the globe were also studied, but no appreciable gain was found, and as this construction necessarily introduced many complications and increased the expense of the lamp, it was decided to abandon any attempt to develop the lamp in this direction.

The peculiar characteristic of the glower, which is shared to some extent by most electrolytes, necessitated the introduction of a compensating resistance which would have a large positive temperature coefficient and thus would prevent an excess of current from flowing through the glower, fusing it and destroying it. To find a suitable regulating resistance necessitated a long and painstaking research. Many substances were tried, and among them common iron wire was found to be by far the best. Its corrective value, however, was still inadequate. Finally, Mr. H. Noel Potter secured some pure iron wire and submitted this to test. To his surprise, he found that this sample of iron had corrective value far in excess of that of the samples which had been tried heretofore, and it was evident that if this resistance could be so constructed and protected as to give it a long life, the desired regulating resistance had been found.

If this iron wire were not protected from the atmosphere, the many successive heatings and coolings would rapidly rust it away. The first suggestion, then, which would occur to any one would be to enclose the strip of wire in a globe and exhaust the air. This construction, however, would not answer, because of the so-called "Edison" effect which would then take place. This effect appears when the metal is rapidly heated and cooled in a vacuum. The metal contracts along its length and grows thicker, so that a loop of wire suspended in this way would soon contract until it occupied the shortest distance between the two points of suspension. Mr. Potter suggested enclosing a suitable length of wire in a globe, which was then to be filled with some inert gas, preferably hydrogen. This construction was tried, and the presence of the hydrogen was found to prevent this Edison effect from taking place, and the wire remained unaffected indefinitely. The presence of the hydrogen, moveover, enabled the ballast—as this form of regulating resistance has been called—to be adjusted very accurately to correct for the decrease in resistance of the glowers. Since the change in resistance of the ballast is a function of the temperature, and the temperature depends upon the rate at which heat can be conducted away from the iron by exhausting the globe, the rate of cooling of the ballast can be accurately fixed. In making this adjustment, the bulb containing the ballast, and which has been previously filled with hydrogen, is connected to an air pump, and a definite potential applied to the terminals of the iron wire. The bulb is then slowly exhausted until the desired current is passed through the wire. It is then sealed off, and the ballast is ready for use.

The third essential of the Nernst lamp is the heater. Since the glower is not a conductor when cold, it must be heated in some way before current can pass through it. The heaters which had been used in Europe were coiled spirally around, but not touching, the glower, which itself was in the vertical position. This type of heater seemed undesirable, and an entirely new design was developed, which has proved to be perfectly satisfactory. The heater itself consists of a tube of porcelain wrapped with fine platinum wire and then covered with some non-conducting protective paste. The amount of platinum used makes this the most expensive part of the lamp.

Two or more of these heaters are placed horizontally just above the horizontal glower, and are in circuit when the lamp is turned on. The current passing through the platinum wire soon brings the whole surface of the heaters to a white heat, and these in turn raise the temperature of the glower until a current begins to pass. The passage of the current through the glower, of course, assists in its heating, and after this is started the glower very quickly becomes incandescent. In series with the heater is connected a small cutout which is operated by the current passing through the glower. The cutout is closed as long as the current passing through the glower is not sufficient to excite a small electromagnet which, by attracting a loosely suspended armature, opens the cutout.

When these heaters were first constructed, some difficulty was encountered in preventing a leakage of current through the heated porcelain tube. This difficulty was removed only after a quality of

porcelain had been found which did not become a conductor under the conditions of use. These tubes are the only porcelain parts of the lamp which are now manufactured by the Nernst Lamp Company.

Another fault found in the earlier types of heater was caused by the unequal coefficient of expansion of platinum and porcelain. This caused a rubbing of the platinum across the hard, rough surface of the porcelain, and of course gradually wore this away. This trouble has been eliminated by making the tubes of soft porcelain.

The cutout, which throws the heaters out of circuit after the glower has been heated, consists of a small electromagnet which is excited by the current passing through the glower. This attracts to it the loosely suspended armature, which, when the lamp is not burning, is drawn by gravity so as to close the circuit through the heaters by small silver contacts. In some cases this loosely suspended armature is set in vibration by the opposing forces of gravity and the electromagnet, the exciting current in the magnet being alternating, and it may, in some cases, vibrate sufficiently to produce an objectionable humming. This is now prevented by arranging the cutout magnet so as to act at an acute angle with the force of gravity. In this way the pinion of the armature is held firmly by both forces against its bearings, and there is little tendency for the armature to be set in vibration. In a more recent design a single-pole cutout has been found to be very effective. The small current required by the heater is easily carried by the pivot of the cutout armature.

Some little difficulty was also met with in finding a suitable paste for covering the platinum wire of the heater. This must not only be a non-conductor, but must adhere firmly under the severe changes of temperature to which it is subjected.

There are many small, minor details in the construction of the Nernst lamp which require attention, but the lamp is being steadily improved and simplified. In some of the simpler types of lamp, notably the single-glower lamp, the method of mounting the glower subjected this to a more or less uncertain tension. The leading-in wires, when in a normal condition, lie in two small grooves in the porcelain holder. The later type of holder has three grooves at each end of the holder. When placing in the filament of the lamp, the wires are laid diagonally in the outer grooves, the attachment plugs inserted in the proper connections, and the leading-in wires tightened to hold the glower in place. Then the wires are slipped over into the central notches, thus giving sufficient play for the glower.

In some cases, where a number of lamps are mounted on a single circuit, the cutout mechanism is omitted and a third wire is carried to each lamp. This supplies the heating current. In lighting the lamps, the switch is closed which connects the heaters to the circuit. After the lamps have been lit, the starting switch is opened and this cuts out all of the heaters. This arrangement is particularly suitable on shipboard and in other conditions where the action of the cutout might be uncertain. If the lamp is held in its normal position, the cutout will still operate, although subjected to considerable vibration. The effect here is simply to delay the lighting of the lamp.

The blackening of the holder porcelain has been considered a serious defect of the lamp. This can be corrected by using a whitewash, with which the holder is coated. When this has become darkened, the deposit is easily scraped off, and another coating applied. However, an examination of the lamp after it has been burning for some time will show that this deposit does not take place at points exposed to the high temperature of the glower. In other words, the deposit of platinum black takes place only in shadow, or points not directly exposed to the light from the glowers, and therefore this whitewash hardly seems necessary.

It is not an easy matter to rate these lamps for efficiency. The distribution is so different from that of other types of illuminants that a comparison which does not consider this feature of the lamp can not be satisfactory. Practically all of the light is in the lower hemisphere. This is claimed to be a valuable characteristic of the lamp, as no reflectors are needed. A comparison of Nernst lamps of different sizes shows a slight increase in efficiency with an increase in size. This is, of course, due to the higher temperature at which the two or more glowers are maintained, as compared with that of a single glower; each glower helps, to some extent, to heat its neighbors. It is claimed that the Nernst lamp will give an equal illumination as compared with an incandescent lamp, for one-half the watt consumption. The quality of the light given by this lamp is also one of its strong points, as it approaches more nearly to that of daylight than any other artificial illuminant.

The glower is supposed to act as an electrolyte, though this has not yet been definitely proved, but the following observations point to this conclusion. The glower consists of a mixture of oxides of the rarer earths, as it is found that a mixture acts as a better conductor than a single oxide. The material of the glower consists of two elements—the metal and oxygen. When a direct current is passed through the glower while in a vacuum, it becomes black and oxygen is set free. This black color will disappear when air is admitted to the heated glower, as the oxygen then acts as a depolarizer. Under this action of a direct current, a metallic tree is found to grow out through the centre of the glower. This, however, never reaches the opposite end of the glower so as to form a short-circuit.

The engineers who developed the Nernst lamp have made a very careful study of light distribution. They have come to the conclusion that the most useful rays are those which are projected in a vertical direction, as horizontal rays serve merely to dazzle the observer; and the aim has been to secure that distribution of light which is most effective. They further distinguish between illumination and artistic lighting, claiming that they are two very different fields for work. When illumination, pure and simple, is desired, the lamps should be placed well above the line of vision, and the units should be so located as to distribute the light more or less uniformly. In this method of illumination, the Nernst lamp is found very effective, and its use has been increasing rapidly ever since it was first introduced.

The Nernst lamp is being introduced in the United States under the active management of Mr. Calvin W. Rice, second vice-president of the Nernst Lamp Company, Pittsburg, Pa.

American Institute of Electrical Engineers.

At the meeting of the board of directors of the American Institute of Electrical Engineers, Friday, October 24, the following associates were elected:

Victor Shaeffer Beam, Mark Brewer Beattie, John Richard Bainton, Curtis C. Collins, Frank Toulmen Copp, William Griffith Davis, Eugene Elmer Dudley, Walter Lowe Fairchild, Murray Charles Godbe, Coral Payne Goodby, Guthrie Gray, Frank Wells Hall, James Henry Hamilton, Harry Ariel Haselden, John Samuel Henderson, Edward Herbert, Julius R. Jacobson, Richard Harry Johnston, John MacCallum Jolly, Hall Farington Hoxie, Benjamin Needham Jones, Robert Clay Jones, Arba Vanderburg Joslin, Adolph Somers Kappella, John Leo Livers, Alexander Lodyguine, Rupert Thomas MacKeen, S. C. Medbury, Jr., William Nesbit, James Gillespie Blaine Replogle, Robert Julian Scott, Charles Leroy Stone, William Lawrence Waters, Robert Baird Williamson, William Allen Woolford.

Machine Tool Progress—IV.

By Charles E. Hadley—*Concluded.*

PROBABLY no system of tools is more complete than that of the milling machine and none is more directly and effectively a labor saver. Primarily intended to reduce the cost of planing operations where parts are to be duplicated, it has also reduced filing operations to a minimum, and its variety of form and application is extremely diverse.

We have the plain machine with straightaway feed, with double and single heads and spindles disposed vertically and horizontally to take the work of the planer in manufacturing operations. The shaper shares its work not only in duplication of parts but in general and tool work with the various forms of column machines with both hand and power feed, while the die-sinking machine controlled by hand and the profiling machine and cam-cutting machine controlled by a former have largely displaced the chisel and file and enormously reduced the cost of manufacturing.

It is beyond the space limits of these columns to show more than a few representative machines, as the list of good machines is very long.

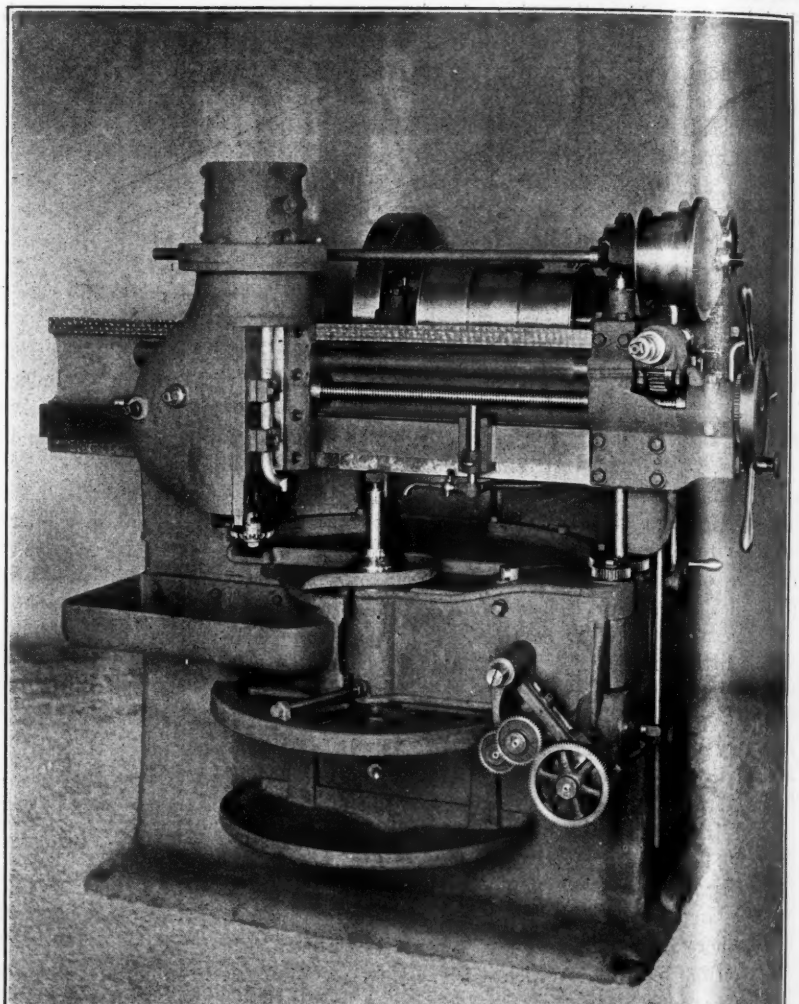
The importance and individuality of the milling machine field have led large manufacturers to make a leading feature of them, and in some cases their specialty and exclusive product. We show an illustration of a Universal machine, manufactured by the Waltham Watch Tool Company.

The Universal milling machine might well be called the universal machine, as there are few operations it can not perform. It is, therefore, a prime necessity in the jobbing shop, and in the way of meeting requirements as a makeshift it may be said to be the important tool above all others. It can, on a pinch, substitute for the lathe in many operations. Drilling, boring, gear and rack cutting, die-sinking, keyway cutting, coarse thread cutting and even short turning come, in extremity, within its province.

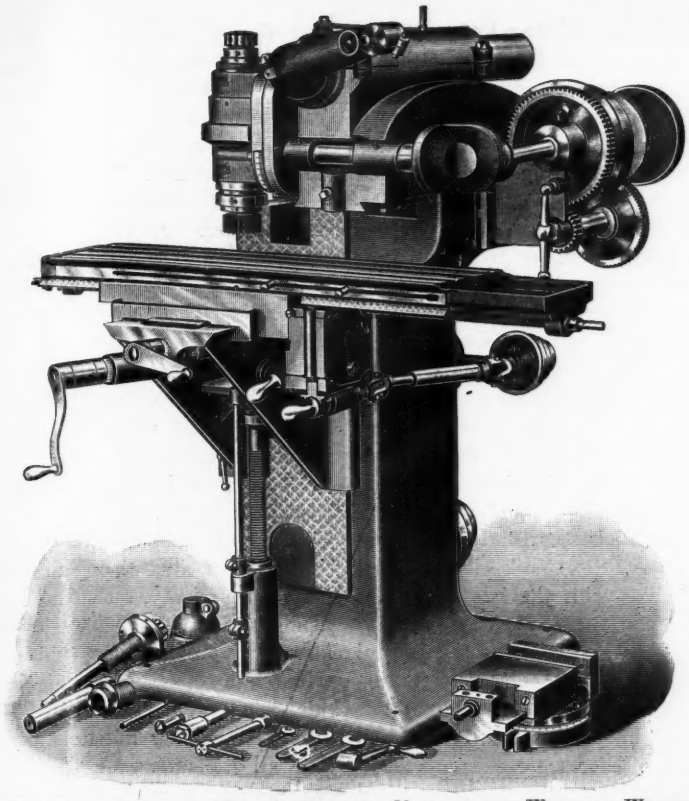
It is surprising to see how much work is done still in an old-fashioned, uneconomical way when we step out of the pure manufactory into the machine shop.

The most rare quality in the Yankee machinist's make-up is patience, as it does not mix well with nervous aggressiveness, consequently the time and expense of preparation as an investment, which in the early stages would figure as shop expense, deter the responsible ones from making thorough preparations for a job. An assortment of cutters costs more than a few planer tools, their selection and setting take more time, and the desire to begin the cut brings the same results as blindly jumping on a local train because it is the first to come along, and a few minutes later, contemplating with perhaps more than mental blasphemy from the stillness of the siding, the express whirl by which you might have taken by waiting ten minutes. It is natural for some of us to feel we must be doing something, especially if a lot of hurry-up stockholders are impatient. So we tell them the chips are falling—"man has it in the lathe or the shaper" when the piece should be in the annealing furnace and the man selecting or making the cutter to do the job in the milling machine.

On the other side, those familiar with the attitude of great and successful manufacturers have noticed how quick they are to adopt improvements in tools in a manner to shock the old-timer and gladden the heart of the junkman. They know how to figure; they do not stand aghast at the cost of a fresh installation of machinery and a new system of tools and fixtures, but immediately set to work cal-



BACK VIEW, 36-INCH GEAR SHAPER, MADE BY THE FELLOWS GEAR SHAPER COMPANY, SPRINGFIELD, VT.



THE VAN NORMAN DUPLEX MILLING MACHINE, MADE BY THE WALTHAM WATCH TOOL COMPANY, SPRINGFIELD, MASS.

culating the margin of saving on the contract and making practical comparisons to see if it exceeds the interest on the investment. If it does the change takes place.

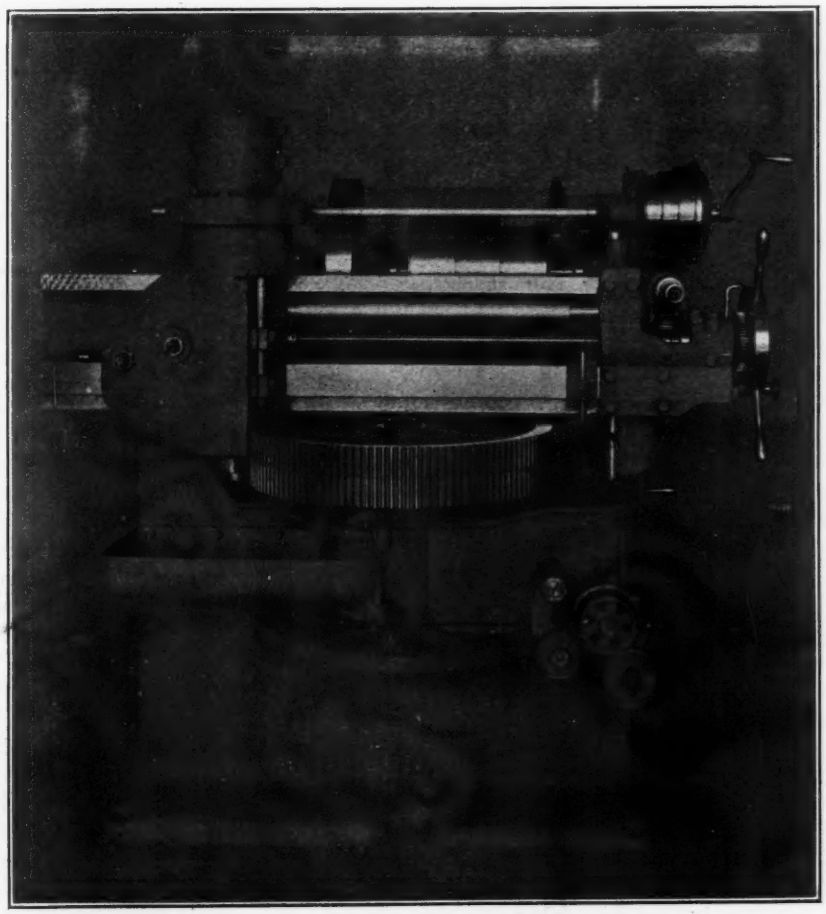
Every little operation is open to this comparison, and the successful man, even where his equipment is very small, is working his head constantly on such problems.

The good machinist at the bench is, unconsciously almost, making all through his work such comparisons. From such mental effort springs the succession of improvements that are regularly decreasing the cost of production. When the regular type of machine is brought to practical perfection its specializing begins and devices are developed for exclusive application to certain operations. This is done for a twofold benefit. One, to apply the most direct and nearly automatic means to a purpose and, second, to eliminate the unnecessary elements of the more universal machine on the score of economy in investment.

For instance, in small gear cutting in standard parts, the machine is made to take the particular piece of work and is entirely automatic, but at the same time comparatively inexpensive, as there are no adjustments, no gear combinations for graduation, no excess of dimensions. With all the development of tools comparatively little has as yet been done in specializing anything but the larger fields. It takes a strong man to put behind him the temptation to equip with tools which, with a few additional parts, could be applied to other purposes than the one in view. And at the present writing it is undoubtedly wise in certain instances to leave open an avenue of retreat.

Volume of business dictates methods, and the factory equipment of a handvise and a file may, under certain circumstances, be classed as bordering on the realm of wanton extravagance, until classification among the smaller establishments shall warrant something further. Puck's tramp, whose profession was picking blossoms off century plants, would be warranted in providing himself with a labor-saving device for the work had he made a deal with his competitors to surrender other business for a monopoly in that line.

As in the case of lathe development, the ultimate growth was underestimated in using the significant term screw machine. So in the evolution of the planer the breadth of application of its modified operations was not anticipated when its



FRONT VIEW, 36-INCH GEAR SHAPER, MADE BY THE FELLOWS GEAR SHAPER COMPANY, SPRINGFIELD, VT.

important descendant was named milling machine. The inserted tooth cutter, with its immense metal removing capacity, was certainly not so vivid an object in the mist of the near future as the millstone, whose similarity to early cutters has been noted.

The product of the one was the by-product of the other, that was all.

We have dealt with the two fundamental machine operations in touching upon the long list of modifications, special and otherwise, which has been evolved in this last quarter century of the age of steel.

Nowhere is improvement in methods more noticeable than in the matter of portable conveniences. The flexibility of compressed air as a means of power transmission has brought into existence a wide variety of tools for operation upon pieces of work too heavy to be moved about economically. With a factory piped for compressed air from a central compressor plant many operations may be done by power in the way of chipping, drilling and riveting formerly done by hand through the medium of the hammer and chisel or Scotch drill. Incidentally, this ever ready supply of pressure comes in handy for other work; for the supply of a small hoist or crane; to furnish, through reducing valve, wind for forges or ovens.

The Collected Physical Papers of Henry A. Rowland.

The volume containing the physical papers of the late Professor Henry A. Rowland is now nearly ready for distribution to subscribers. This has been edited under the direction of President Remsen and Professor Welsh and Professor Ames, and every effort has been made to present this as a suitable memorial to their colleague. The book contains about 750 pages, royal octavo, and the subjects treated cover a wide range. The memoir contributed by Professor Mendenhall serves as a biographical sketch. The great memoir on the mechanical equivalent of heat and the fundamental researches in magnetism are included. On the magnetic effect of electrical convection, and on the value of the ohm, essays are included. The discovery and theory of the concave grating and a long series of investigations made in the field of spectroscopy are here given, as indeed are all the valuable contributions of Professor Rowland to physical science. Orders may be sent to Professor Joseph S. Ames, Johns Hopkins University, Baltimore, Md.

An Electrical Testing Laboratory.

It is unfortunately true that, although electrical measuring and testing instruments are reliable and accurate, there is a sad neglect on the part of operating engineers in checking and verifying their instruments. The reason for this doubtless in many cases arises from the fact that the smaller stations do not see their way clear to employing experts who can undertake this work for them. Moreover, until this time there have been few places where electrical instruments could be sent for calibration or adjustment, except back to the makers. Now, however, a laboratory fully equipped for all work of this kind has been established by the Lamp Testing Bureau.

The bureau has secured three floors at 14 Jay street, New York city, and has equipped these with the latest and best testing appliances that can be secured.

The eighth floor contains the general offices and a general electrical testing laboratory, well equipped with portable instruments of standard makes, as well as instruments for more exact measurements. Among these may be noted potentiometers, by Wolff and Leeds & Company, Kelvin balances, an Anthony Wheatstone bridge, a Thompson double bridge, manufactured by Wolff, and a complete assortment of standard manganese resistances, manufactured by Wolff, ranging from 0.00001 to 100,000 ohms.

For alternating-current measurements, besides a full equipment of portable instruments of standard makes, there is a Rowland electrodynamometer, which is very convenient for certain work of this class. A Kelvin electrostatic voltmeter, mounted with a mirror and telescope, is here used as a reference instrument, and permits very accurate comparisons to be made between alternating and direct-current voltages.

On this floor there is a small but well equipped chemical laboratory, where standard cells are prepared and such chemical analyses as may be required are made. Here also is found the standard photometer built by Leeds & Company from special designs drawn up at the bureau. This photometer is equipped with Lummer-Brodhun contrasting photometer, and with an arrangement of mirrors, by which the mean spherical candlepower can be obtained more quickly and easily than by the usual method. This photometer is furnished with the Hefner amylacetate standard and a pentane standard, with instruments for correcting these for atmospheric conditions.

The seventh floor is arranged for testing dynamos and motors of moderate capacity. Here recording wattmeters may be mounted free from vibration. A calorimeter enables the effect of temperature on the accuracy of these instruments to be determined. This is arranged for testing motors through a wide range of temperature. On this floor there is a battery with over 300 cells of accumulators, arranged in sets to give convenient pressures. These are used for testing all direct-current instruments. A small rotary converter on this floor can be run from the battery, furnishing alternating currents of any voltage within the range of the accumulators. This is used for calibrating and testing alternating-current instruments.

The sixth floor contains the lamp-testing laboratories, where all commercial tests for efficiency, spots, vacuum, candlepower and life are made. Two photometers are provided for this work, each fitted with apparatus for quick and accurate comparison of lamps. The lamp racks for making life tests are arranged for all voltages. A specially wound transformer furnishes pressure varying by one volt from 100 to 150. Each rack has a particular pressure assigned to it, and in making a lamp test each lamp is placed in a certain socket. Whenever it is removed for candle-power measurements, it is returned to the same socket, so that any tendency of the filament to droop during the life of the lamp will be detected. The pressure for each lamp is adjusted by placing in series with it a small resistance, which adjusts it within a tenth of a volt. Current for the lamp tests is furnished by a motor-driven alternator, equipped with a reliable potential regulator which maintains a constant pressure independent of that supplied to the motor.

In selecting lamps for testing, a small lot is taken from each barrel and carefully examined for all defects. Should any one defect be found to occur frequently, one inspector is delegated to examine all lamps for this one defect, and any barrel in which this is found to occur frequently is condemned. After inspection, the lamps selected for life tests are sent to the testing laboratory, and there measured, rated and assigned to the proper racks. The value of this systematic method of inspecting and testing lamps has been demonstrated by the marked improvement in lamps during the past seven years.

The bureau will make and sell standard incandescent lamps for photometric measurements. Another convenient standard

which has been developed by the bureau is the lamp rated for current. These lamps are very carefully measured after being seasoned, and the current consumption at a definite voltage is marked upon the lamp. It is intended to place this lamp in the socket of the lamp under test, and bring the voltage to that marked on the base of the lamp. The current then taken by the lamp is known, and this enables the ammeter to be checked, correcting at the same time the current taken by the voltage. The convenience in this method of checking the ammeter will be recognized by all who have made photometric measurements. The bureau will also make and sell standard cells.

It has been thought that there was need for a laboratory such as that at the Lamp Testing Bureau, and its facilities are now placed at the service of the public. The bureau is ready to undertake commercial tests of electrical supplies of all kinds, conductivity of copper wire, capacity and inductance, hysteresis losses, insulation resistance, cable testing, and calibration and rating of recording meters of every description, either at the laboratory or after installation. When the work can not be done at the laboratory, the bureau stands ready to send an expert to the spot, enabling companies to have tests made of their material after it is in place. This is an important point in testing cables and some types of meters.

Lamp tests of all kinds will be made. Thus, a station can buy lamps on specification, and the bureau will undertake the test of these lamps to see if the manufacturer has adhered to his contract. Last year tests representing 50,000 lamps were made at the laboratory of the Lamp Testing Bureau, and from these accurate rating of lamps for candle-power, life and value was obtained. The laboratory maintains a corps of experts which has been especially selected and trained for this work.

Book Review.

"American Municipal Progress." Charles Zueblin. New York. Macmillan & Company. Cloth. 380 pages. 7½ by 5 inches. Supplied by the ELECTRICAL REVIEW at $1.25.

This book gives an interesting discussion of the progress which has taken place in this country in municipal control of public works. After discussing municipal sociology, the author takes up the questions of transportation, public works, sanitation, public schools, public libraries, public buildings, parks and boulevards, public recreation, public control, ownership and operation. Some statistics of the principal American cities are given in appendixes. The book should be a welcome one at this time to all interested in public questions.

Alfred H. Cowles.

Alfred H. Cowles is the second son of the late Edwin Cowles, founder and editor of the Cleveland *Leader*. He was born in Cleveland, Ohio, in December, 1858. He attended the public schools in his native city, and later spent two years at the Ohio State University, making chemistry and metallurgy his special studies. From here he went to Cornell University, and remained there four years, continuing the study of his specialties. At Cornell he was active in athletic circles, and was made captain of the varsity crew in his senior year. After leaving Cornell, Mr. Cowles spent some time in New Mexico, developing mining property owned by his father.

For the past seventeen years his principal work has been along the lines of metal-

MR. ALFRED H. COWLES.

lurgical research and application. In connection with Eugene H. Cowles, his elder brother, he recognized the possibilities of the electric furnace and brought this to a high state of development, the two brothers being the pioneers in this work.

A company was organized and works were built at Lockport, N. Y., in 1886, where a large water power was available. Here much original research was carried on and many valuable substances discovered and processes developed and patented.

The most important application at this time was in the production of aluminum alloys. Between 1885 and 1890 aluminum was first offered for sale cheap in commercial quantities, principally as aluminum bronze.

From the researches carried on at the Cowles laboratory many important discoveries and inventions have been made. Among these we may note the discovery of calcium carbide. The commercial development of this business is due to Major J. T. Morehead and Messrs. E. N. Dickerson and Thomas L. Wilson, but the work is done along the lines followed by the Cowles brothers, by whom Mr. Wilson was employed. The Union Carbide Company and the Electro-Gas Company are now licensees under the Cowles patents.

Another notable application of the electric furnace was in the manufacture of carborundum. This substance was produced in the Cowles furnace in 1884, and the process patented. This was some years before this material was brought out by Dr. Acheson, to whom credit must be given for introducing this valuable abrasive in the arts.

Carbon bisulphide is now made in the electric furnace at Penn Yan, N. Y., by Edward R. Taylor, who was formerly connected with the Cowles company at Cleveland.

In 1889 and 1890 Dr. Redmond experimented for nearly a year at the works of the Cowles Syndicate Company, at Stoke-on-Trent, in England, using a Cowles furnace. The results of his work are shown to-day at Niagara Falls, where phosphorus is produced in the electric furnace.

Commercially pure aluminum has been manufactured by the Cowles company, but work along this line has been suspended during litigation with the Pittsburg Reduction Company. Mr. Chas. M. Hall, the inventor of the Hall process now used by the Pittsburg Reduction, spent some time at the Lockport works in experimental work in developing his process.

Undoubtedly, much of the remarkable progress of electrometallurgical processes for the last decade is due to the work of the Cowles company. It was the first to develop and apply the electric furnace on a commercial scale, and one important feature of its methods was in the use of the electric current for heating. This method of internal heating has been found necessary in many processes.

Personally, Mr. Cowles is very pleasant and unassuming. He is still active in the interest of scientific research, as well as the commercial development of electrical tests.

A circular mil is a circle one one-thousandth inch in diameter. A wire one foot long and one circular mil cross-section is called a mil-foot.

The Tyneside, England, Tramways and Tramroads.

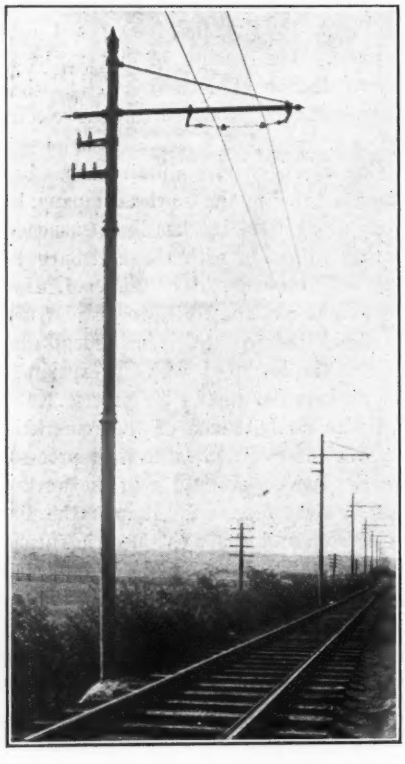
(From Our Special Correspondent in Great Britain.)

THE opening of the first portion of these tramways in September is perhaps of somewhat special interest as they are distinguished by one or two novel features, some of which more nearly approximate to American conditions of working.

The district through which they run is of great industrial importance, as some of the principal shipbuilding yards and engine works in the country are situated along the route, there being besides a large resident population. The lines are now completed through Gosforth, Wallsend and Willington Quay to North Shields.

When the Newcastle Corporation has completed the extension in Walker, which it has in hand, direct tramway communication will be afforded along the whole length of the north bank of the River Tyne from Newcastle to North Shields.

It would perhaps be convenient to draw attention to the distinction between tramways and tramroads, a tramroad being



TRACK BEFORE BALLASTING, TYNESIDE, ENGLAND, TRAMWAYS AND TRAMROADS.

the name applied in Great Britain to a tramway when laid on any ground other than public roads. In the Tyneside system the tramroad, which runs from the residential quarter of Gosforth to Wallsend, is constructed on land owned by the company, and as there is no other traffic higher speeds are attainable than prevail in ordinary tramway practice. It is also found that even allowing for the cost of the land, the capital expenditure is lower than in the case of a tramway, since it is possible to dispense with a concrete foundation and stone paving.

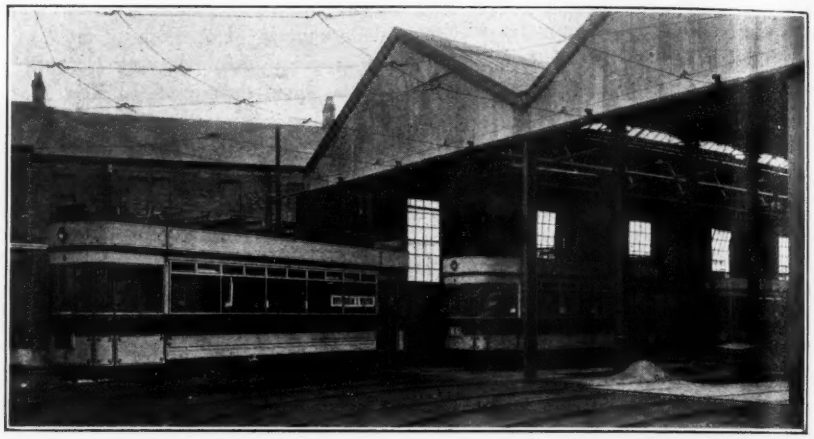
On the tramroad portions of the line a special form of grooved rail, with a high check, has been adopted, the track being laid on wooden sleepers, as seen in one of the photographs. The tramroad consists of a single track with passing places located where the line crosses a public road and at points where the speed would, in any case, have to be reduced. This is, I believe, the first instance in this country of a trolley line running on purely private land purchased by the tramway company.

The tramway portion between Wallsend and North Shields, a considerable portion of which is double track, is of the usual construction, the gauge being four feet eight and one-half inches, and the distance between the centres of the tracks eight feet four inches.

The overhead trolley wire, of 00 S. W. G., is of the special form shown in the diagram, which also shows the type of mechanical ear employed on the whole of the route except at curves where ordinary soldered ears are used. The perfect continuity of the lower surface of the wire obtained by this system of suspension enables the trolley to run much more smoothly than with soldered ears.

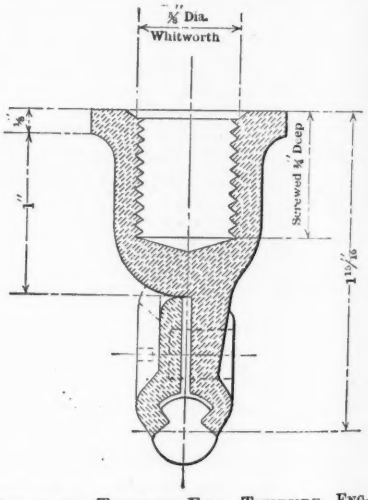
The whole of the track and overhead equipment has been constructed by Messrs. Dick, Kerr & Company, Limited. The special work is of Messrs. Hadfield's manufacture, their manganese steel being used throughout.

The rolling stock at present consists of four bogie cars, each carrying 112 passengers and fourteen single-truck cars, having



CAR SHED ENTRANCE AND BOGIE CARS, TYNESIDE, ENGLAND, TRAMWAYS AND TRAMROADS.

a capacity of eighty passengers. They are all of the double-deck type with complete vestibule at each end. The bogie cars are provided inside with combined longitudinal and transverse seats, the four-wheel cars having longitudinal seats only. All cars are fitted with Tidswell's lifeguards and both hand and electric brakes, the



DETAIL OF TROLLEY EAR, TYNESIDE, ENGLAND, TRAMWAYS AND TRAMROADS.

latter being of the Newall magnetic type, the resistance in connection with which is used in winter as a car heater. The great power of the brakes is demonstrated in the ease with which the heavy cars can be

pulled up on the gradient of 1 in 11 at Chunk Bank, near Wallsend.

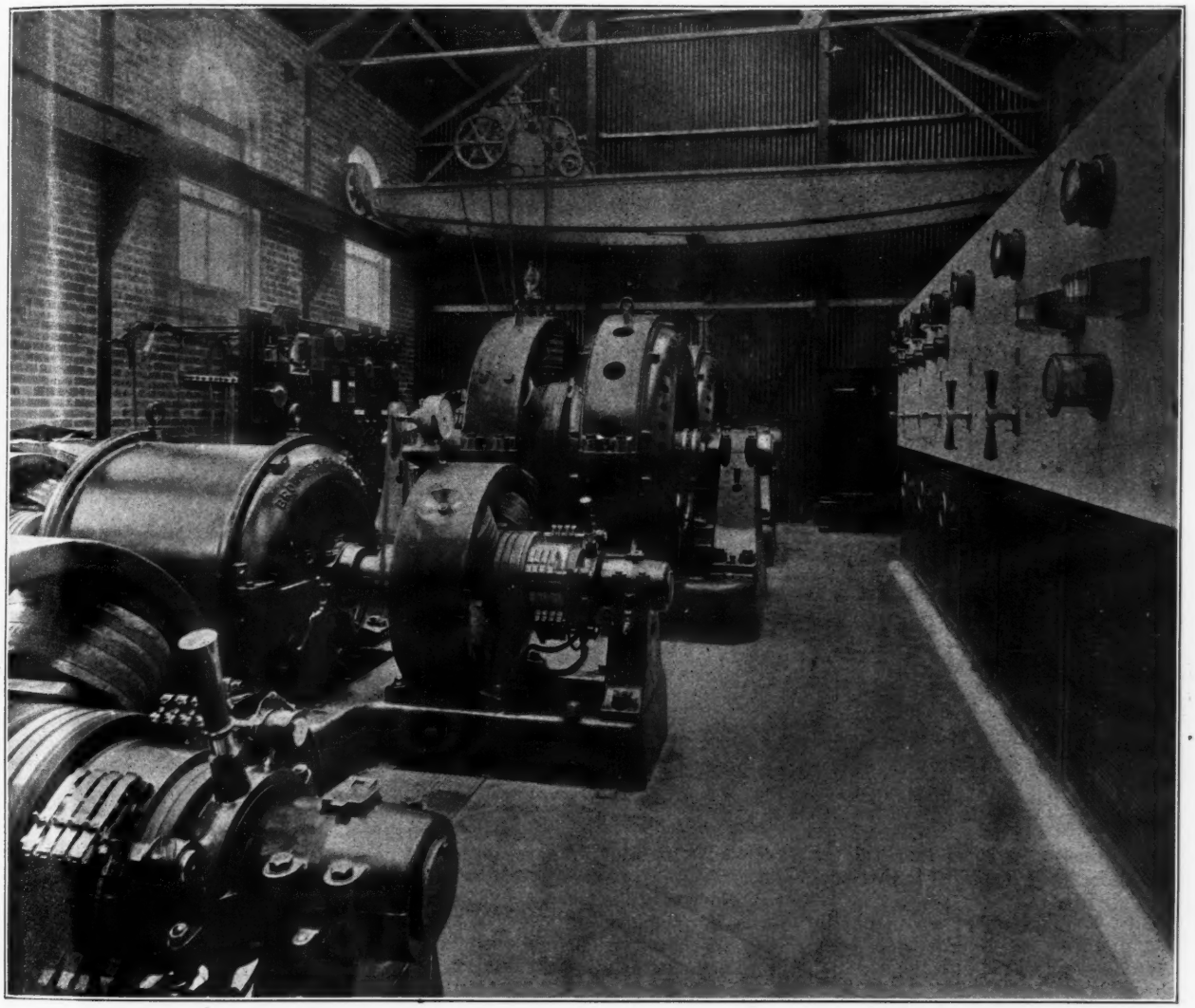
The bogie cars are provided with a four-motor equipment, each motor rated at thirty horse-power when running with a line pressure of 500 volts. The wheel base of the bogies is four feet, with twelve feet six inches between bogie centres, and the single-truck cars have a wheel base of six feet six inches. Steel-tired wheels are used throughout. The car contract has been carried out by the British Westinghouse Electric and Manufacturing Company, the bodies having been supplied by Messrs. Geo. F. Milnes.

The company has not found it necessary to build a power station, as it is able to obtain current from the Newcastle-on-Tyne Electric Supply Company's Wallsend power station, and the Tynemouth Corporation's power-house at North Shields. The former has already been described at length in connection with the inauguration of the Tyneside power scheme last year by Lord Kelvin. It will therefore suffice to say that electricity at a pressure of 5,500 volts three-phase and a periodicity of forty cycles per second is transmitted by means of three-core paper-insulated cables to the various substations, from which it is distributed for tramway purposes at a pressure of 500 volts, continuous current. One of the illustrations depicts the company's substation at Gosforth.

This substation not only supplies current for the tramways, but also lights the district of Gosforth. The two small machines in the foreground are each of 75 kilowatts capacity, and are double-ended, supplying a 480-volt, three-wire continuous network. The two larger machines are at present used for traction purposes only, although when the lighting load increases they will be used for this also, and further sets will be installed to supply the tramways. The capacity of each of these traction motor-generators is 500 kilowatts. The synchronous motor is supplied direct with three-phase current at 6,000 volts, and runs at 300 revolutions per minute. The continuous-current generator is compound wound for 500 volts at no load to 550 volts at full head.

In these substations the motor-generators and high-tension switch gear have been supplied by Messrs. Richardson, Westgarth & Company, of Hartlepool, and the low-tension switch gear by Messrs. A. Reyrolle & Company, of Hepburn-on-Tyne. It will thus be seen from the names of the various contractors that the equipment of the whole system is purely British.

The above description is confined to the line as already constructed, but further powers were obtained in Parliament last session for extensions in several directions, which will widen considerably the area served by the company's system.

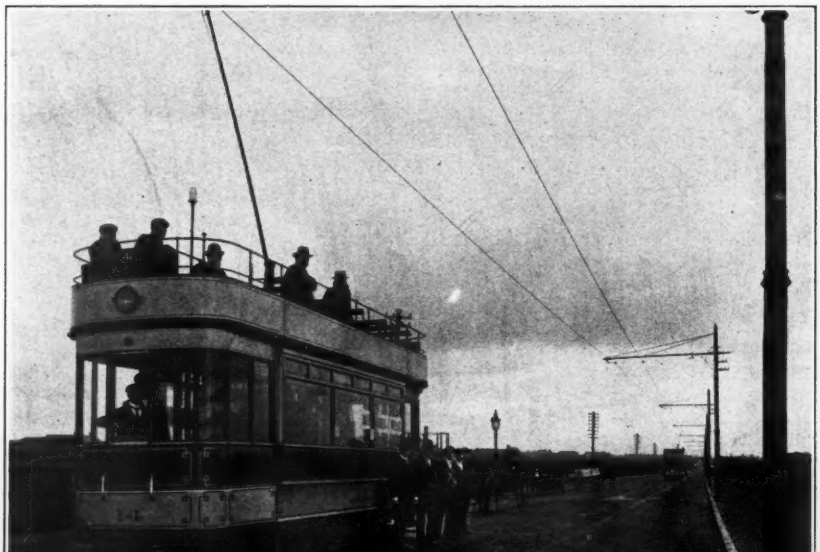


THE GOSFORTH SUBSTATION, TYNESIDE, ENGLAND, TRAMWAYS AND TRAMROADS.

In conclusion, it may be pointed out that this system of tramways is one of the latest and most advanced phases of electric traction work in Great Britain, the tramroad portion being but one step removed from heavy electric railways in open country, this being the next step which every electrical engineer here is looking forward to. With the North Eastern Railway Company taking such decided steps to convert its steam lines to electric ones, together with the several large municipal and privately owned electric companies in the northeast corner of England, served by the Tyneside Tramroads and Tramways Company, we have good reason for being thankful for the enterprise being displayed in that portion of our island.

Finally, I would record my thanks to Mr. C. H. Merz, of Newcastle-on-Tyne, who kindly supplied me with the material for this article. A. W.

London, England, November 1.



THE TRAMCARS, TYNESIDE, ENGLAND, TRAMWAYS AND TRAMROADS.

Professional Etiquette.

The following letter has been sent by the Council of the British Institution of Electrical Engineers to the clerks of some of the larger counties and boroughs:

October 17, 1902.

SIR—As it has come to the knowledge of the Council of this Institution that in several cases consulting engineers have applied for employment, and in others local authorities have advertised for consulting engineers, I am instructed by the Council to forward a copy of the code of etiquette in such matters that, in their opinion, ought to govern all those belonging to the Institution.

I am also instructed to urge upon you the great importance of having electrical work well done at the most moderate outlay; and would point out that by advertising, or by employing those who solicit employment, either directly or by agents, local authorities may deprive themselves of the services of electrical engineers of high standing and great experience.

W. G. MCMILLAN, Secretary.

Standard of Professional Etiquette for Consulting Electrical Engineers, as approved by the Council of the Institution of Electrical Engineers, July 16, 1902:

1. No consulting engineer should solicit employment as consulting engineer verbally, by letter, by agent paid by commission or otherwise, or by any other means.

2. No consulting engineer should answer advertisements for consulting engineers.

3. No consulting engineer should advertise for employment.

4. No consulting engineer should pay by commission or otherwise any one who introduces clients.

5. No consulting engineer should receive trade or other discounts, or surreptitious commissions or allowances in connection with any works which he superintends.

6. A consulting engineer who is also directly or indirectly interested in any contracting or manufacturing business should inform his client in writing what his connection is with such contractor.

Notes on Laying, Repairing, Operating and Testing Submarine Cables.

This book, which has been prepared by Captain Edgar Russel, of the United States Signal Corps, under the direction of Brigadier-General A. W. Greeley, chief signal officer of the United States Army, contains some valuable notes upon the construction, laying, repairing and operation of submarine cables. Instructions for making joints are given, and the necessary apparatus for operating the cable is described in some detail. Some valuable hints on the care and adjustment of signaling apparatus are given. A chapter on cable testing describes the necessary instruments and methods of making tests for resistance of conductor, capacity and insulation resistance. The location of faults is considered briefly, and the most usual tests in this work are explained, with a description of suitable testing sets and the methods of using these. This includes measurements of electrostatic capacity by means of the telephone, determination of electric polarities, the Murray loop method and the Varley loop method of locating grounds or crossed wires, and the manner of locating broken wires by means of a telephone. The last chapter in the book was prepared by Lieutenant-Colonel Samuel Reber, and considers factory tests, together with a number of tables of electrical properties of submarine cables. A list of useful constants and formulæ is included in the book.

Certain Electrical Units.

At the recent meeting of the American Electrochemical Society Mr. Alfred H. Cowles read a paper on "Certain Electrical Units," in which some relation between mass quantity and electrical quantity was suggested. The paper created considerable interest, although the relations deduced by the author were thought to be simply accidental. The following are the data upon which Mr. Cowles's deductions are based:

If the atomic weight of hydrogen be taken as one, and the calculation is based on Dr. Edward W. Morley's determination of the weight of a litre or cubic decimetre of hydrogen, $0.089873 = 0.0000027$ gramme, as given in Dr. Morley's paper on the "Atomic Weights of Hydrogen and Oxygen," in the "Smithsonian Contributions to Knowledge for 1896," we must then attribute to silver an atomic weight of 107.11. Lord Rayleigh's determination of the electrochemical equivalent of silver is 0.001118 gramme per coulomb. This would make the electrochemical equivalent of hydrogen 0.00001043786. Under these premises the kilocrith Col, or 100 international amperes for one sidereal day, liberates 1.00071 cubic metres under standard conditions of pressure and temperature.

The metre is not exactly one ten mil-

lionth part of the quadrant of the earth from the pole to the equator. The most reliable data as to the distance from the pole to the equator, are the determinations made by Clarke in 1880, based upon all the arcs of the earth that had been measured up to that time. He found the distance from the pole to the equator to be 10,001,868 metres. Were we to correct the length of the metre in the light of this more reliable data, the cubic metre would then become a trifle larger, and the 100-ampere current would then give 1.00015 cubic metres of hydrogen at 0 degree centigrade at the pressure of the atmosphere at sea-level and 45 degrees latitude in one sidereal day. The sidereal day is 86,164,-091 mean solar seconds, and measures the true revolution of the earth on its axis. This agreement is so close that it is well within the limits of error of the determinations of the various constants, and it naturally raises the very important question as to whether the agreement is absolute or not. Taken in connection with the law of Avogadro and the valencies of the elements, this agreement reaches to every element. Hence, if this connecting link could be proven fundamental and a necessary consequence of the dimensions of the various units involved, the periodic law of chemistry, the law of gravitation and Coulomb's law of attraction between electrically charged bodies, could all probably be brought within the scope of some broader generalization.

The unit of quantity suggested by Mr. Cowles is very practical. It is easy to remember that 100 amperes for one day will free one cubic metre of hydrogen, under standard conditions of temperature and pressure, and equivalent quantities of all other elements. The name suggested for this unit is kilocrith Col. For those who use the English system of units, the pound Col should be convenient. This depends upon the fact that 500 amperes for one day will free one pound avoirdupois of hydrogen within one-half of one per cent.

ELECTRICAL NOTES FROM EUROPE.

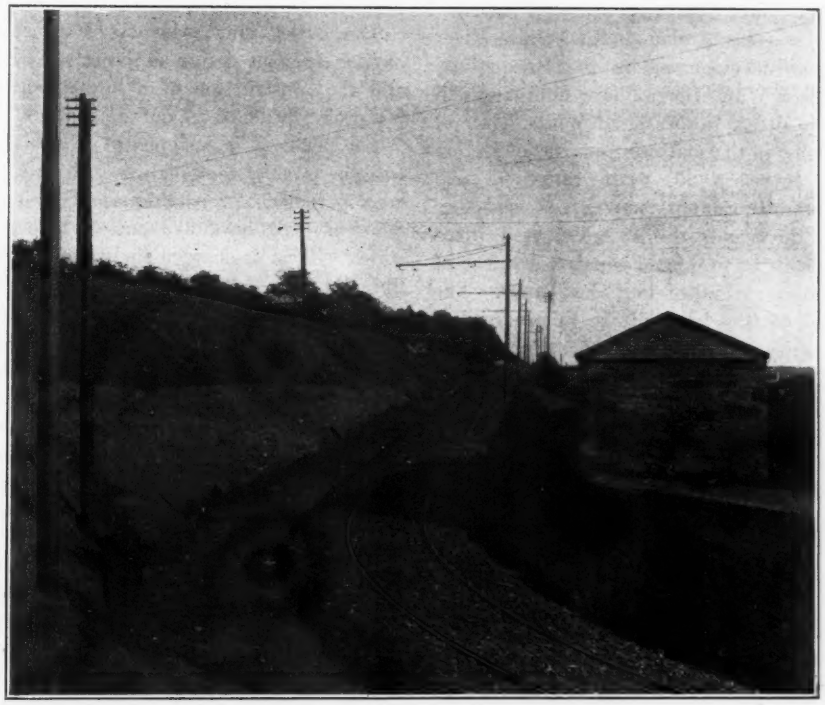
[*By Our Special Correspondent.*]

An interesting hydraulic plant is being installed in Saxony, in the centre of an extensive agricultural district, and current will be used not only for lighting the different villages, but also to operate agricultural machines, and special oufits have been designed for the latter case. The plant is located in the town of Crottorf, which is situated on the railroad leading from Magdeburg to Halberstadt. The town occupies the centre of the Oschersleben district, which is covered with small villages, farms, refineries and various establishments. The region is fertile and the farms produce cereals for the most part. A single station has been erected to supply the whole territory. It will use both hydraulic and steam power. The former is obtained from the fall of the Bode, which is a tributary of the Saal River. A neighboring coal mine, which is in operation, will supply the fuel at a small expense. The hydraulic plant utilizes a fall of about nine feet, which has a capacity of 160 gallons per second. Three turbines will be installed, each of 185 horse-power. These will all be geared to a main shaft which drives the alternators; the latter one of the three-phase type.

The steam plant has a horizontal compound engine of 250 horse-power. The alternator, direct-coupled, is of the fly-wheel variety with a diameter of eleven feet. A second alternator of like construction will be driven by a 500-horse-power engine. The steam plant will be used during the periods of low water. The electric outfit has been furnished by the Helios Company, of Cologne. A 7,000-volt transmission line will be used and the energy is to be distributed to twenty-seven different centres of population. The district supplied by the plant covers a radius of ten miles. In the small villages the voltage will be lowered by stepdown transformers, but in some of the larger ones there will be provided substations containing rotary converters and storage batteries. In the more important localities the light and power circuits will have separate lines. The transformers for the small places will be placed in kiosks of corrugated iron or in pole-boxes. For the agricultural work, which is one of the interesting features of the plant, a type of rolling carriage has been designed which will contain the transformer as well as the motor necessary for operating the agricultural machines. As hand-labor is scarce in the district this application will no doubt be successful.

The Barmen-Elberfeld-Vohwinkel system of suspended electric road, which was installed some time ago, seems to be meeting with favor according to the last reports. It will be remembered that in the Langen system, which is used here, the cars are suspended by rolling wheels upon a central rail which is held at a considerable height above the ground level by an iron structure. The company which operates the road had an examination made recently by a committee of experts, and their report seems to be quite favorable. One advantage of the system is that the cars can go around very sharp curves at a high speed. Thus a curve of 1,200 feet radius can be passed at a speed of 120 miles an hour. The method of suspension prevents the cars from getting off the track. Some tests were made to find the amount of energy consumed on the road. Over a distance of 9.1 miles, in which twenty-four stops were made, the results showed but 28.8 watts per ton —kilometer. The stations in this case were located 0.4 mile apart. The report favors the Langen system for high-speed lines and suggests the use of such a system suspended over the ordinary roads, as the cars can easily go around the sharp curves which are found here at a speed of 100 miles an hour. C. L. DURAND.

Paris, November 1.



THE TRAMROAD, SHOWING BALLASTING, TYNESIDE, ENGLAND, TRAMWAYS AND TRAMROADS.

The Electric Transmission System of the Snoqualmie Falls and White River Power Company.

A water-power electric generating plant similar to that at Snoqualmie falls is to be constructed in the Stuck River Valley in the near future. Articles of incorporation were filed recently at the state department, the incorporators being Chas. H. Baker, Thomas B. Hardin, Lester Turner, O. D. Colvin and Colonel G. Simpson. Mr. Baker is president and chief engineer of the Snoqualmie company, and a merger is effected of the two companies, the new organization to be known as the Snoqualmie Falls & White River Power Company.

The general plan on the White River power development by the Snoqualmie Falls & White River Power Company will be to divert the water of White River at a point in the southwest quarter of section 35, township 20, north range 6, east, in Pierce County, state of Washington, and to convey the waters thus diverted through an excavated canal, a distance of about eight miles to Lake Tapps. The level of this lake will be raised until it occupies an area of about 5,000 acres, and will serve as a storage reservoir and settling basin. The outlet of this lake will be a short canal and tunnel connecting with a penstock on the brow of the hill overlooking the Stuck Valley. Steel pipes leading from the penstock will convey the water under a head of 450 feet to the water-wheels in the power-house at the foot of the hill; and from the water-wheels the water will escape through a short tail-race into Stuck River. The power-house will be connected in with the present Snoqualmie Falls transmision system by circuits about five miles in length.

The intake at the point of diversion will be constructed of concrete masonry. The level of the river will be raised at this point in order to effect a full entrance of the water into the intake by the construction of a submerged dam across the river, which will be continued to the intake in the shape of an earthen embankment designed to be higher than the river at any stage. There will also be constructed at the intake and in connection therewith, a set of gates for the purpose of discharging the water back into the river and in shutting the same off from the canal at any time it may be desired to do so for inspection or repair purposes.

The inlet canal throughout its entire length will be a thorough cut through earth and cement gravel. The canal will be twenty-five feet wide on the bottom with side slopes of 1½ to 1 below the water line, and 1 to 1 above the water line, and will flow five feet deep. The canal and intake are designed to discharge a volume of water equivalent to 60,000 theoretical horse-power under 450 feet head.

The contour of Lake Tapps is such that the raising of its level would overflow the lake at eight different points, but this is to be prevented by the construction of earthen dams at these particular points. Aside from these dams the only work to be done in connection with the reservoir is to clear about 1,000 acres of land around the lake, and to build a ditch to connect Church Lake with this storage reservoir.

The outlet canal consists of a canal having the same design as the inlet canal, and the construction of a tunnel which is a prolongation of the outlet canal.

The penstock is designed to receive the full discharge of the canal, and which will be constructed of concrete masonry. The penstock will have five outlets through which will be discharged the water to the different pipe lines.

The present development contemplates the installation of one pipe line at present, sufficient in size to deliver 10,000 horse-power. More pipe lines will be added as additional water-wheels are installed. The pipe lines will be of rolled steel plates riveted together and supported by concrete piers and anchored firmly to the earth.

The power-house is designed to accommodate a 50,000-horse-power installation of water-wheels, generators and accessories. The building will be erected in common red brick, although at present it will be erected in part only, sufficient to house a 10,000-horse-power installation of water-wheels and generators. As an adjunct, there will be a machine shop equipped with a lathe, drill press, shaper and blacksmith's forge, with the necessary accessories. There will be installed in the power-house two 3,000-kilowatt generators and two exciters of the Westinghouse type, directly connected to impact water-wheels of sufficient capacity to drive the generators under full load.

There will also be erected, either separately or in connection with the power-house, a transformer house in common red brick, and there will be installed therein 10,000 horse-power of raising transformers.

A frame building will also be constructed near the power-house for the purpose of housing the men who will operate the plant, and which will also contain a dining-room, kitchen and laundry; and rooms for office, store and drafting purposes.

It is expected that the development will proceed upon the basis of ultimately realizing 60,000 horse-power, but that machinery for 12,000 horse-power only will be installed in the generating station at the present time. There will be an entire works upon the same permanent and substantial lines as is in evidence at Snoqualmie Falls. The new power will be available in Tacoma and Seattle in twelve months, and the estimated outlay is $1,500,000.

It is understood that there will be no further extensions at Snoqualmie Falls for a year or more, as it is Mr. Baker's plan to reach Portland, Ore., with his lines, which the White River power will enable him to do with a saving of fifty miles of transmission. The Snoqualmie and White River plants will be run together, and each will serve as a reserve for the other, the idea being for the former plant to carry the load in Whatcom and the northern cities, while the White River plant will supply Portland and the intervening cities lying to the south.

The new industries established in Tacoma and Seattle during the last twelve months are declared to have absorbed the entire spare power of the Snoqualmie plant, so that the company has recently had to decline applications aggregating 3,500 horse-power in excess of its capacity until the new power is ready.

It is reported, locally, that an industrial enterprise larger than any now existing in the Northwest will soon materialize at a point somewhere between Seattle and Tacoma, and that Mr. Baker's new company will furnish several thousand horse-power for its operation.

The capital stock of the new company is placed at $2,000,000, divided into 20,000 shares of $100 each.

Horse Meat Preferred to Automobile Steaks.

The soldier who was reading the bundle of old papers from the United States looked up and said:

"Edison has invented an electric motor that he says will replace the horse."

Here another soldier remarked thoughtfully:

"Then it's up to us to train our stomachs to digest iron, copper and wire."—*Judge.*

Mica possesses the highest insulation resistance and the largest dielectric strength to be found. It requires 1,000 volts to perforate a sheet one mil in thickness. Its chemical constitution is unaffected by high temperatures.

THE DESIGNING OF TELEPHONE APPARATUS—IX.

BY W. A. TAYLOR.

Various different designs for ringing mechanisms have been made, but all successful ones are of the same principle as that shown and described. The main thing to be observed in such designs is to be sure and not have the permanent magnet in the magnetic circuit of the electro-magnet. If that happens the ringer will not last long, for the magnet is soon demagnetized and the apparatus is then worthless. Fig. 21 illustrates how this may happen. C is a coil wound upon a core D. This core is pivoted at the point P. The magnetic lines of force from the coil pass through the core of the coil separating at the point P, passing through the two legs of the permanent

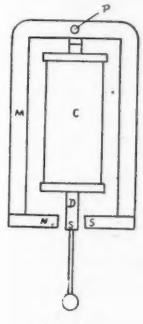


FIG. 21.

magnet M and back to the core at the poles N and S. If a current passes through the coil the magnet will alternately weaken and strengthen the poles of the permanent magnet. For instance, if the terminal of the core is made a south pole, the N pole of the magnet is weakened and the S pole is strengthened; on the next impulse, the S pole is weakened while the N pole is strengthened. The resultant of this alternate strengthening and weakening will be that the poles gradually become neutralized. It will be found that the strengthening of the pole by one impulse will not be as great as the weakening of the next impulse. A ringer of this type may last a long time, provided that very heavy currents are not passed through it.

Fig. 22 represents another form of polarized ringing mechanism which is in common use, and which is a very efficient arrangement. In this form the magnet M is magnetized with the two extremities of the same polarity, while the centre, marked S, is of the opposite polarity. The heads AB of the spool C are of iron, and therefore of the same polarity, normally, as the ends of the permanent magnet M. The armature is of the opposite polarity. The normal or permanent magnetic circuit passes through the two halves of the magnet M, from the point S, through the iron spool-heads A and B, the armature D and back to S. The magnetic circuit, due to a current, passes through the core of C, the head B, armature D and head A, making a local cir-

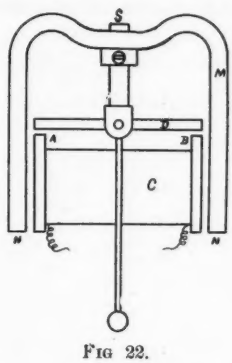


FIG. 22.

cuit not passing through the permanent magnet, except to a very small extent. The magnet is so long and of such a high reluctance that it practically carries none of the lines of force created by the current in the coil. One drawback to this style of ringer is that it is difficult to get a high-wound coil without making the ringer too large or using a very fine wire for winding. The former is not desirable on account of the size, while if a very fine wire is used the ringer is too easily burnt out.

Fig. 23 shows a form of ringer similar in design in which two coils are used. The action of this ringer is identically the same as in Fig. 22. The middle of the magnet is one pole, while the extremities represent the other pole.

There is a modification of the polar-

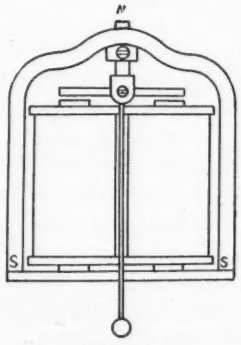


FIG. 23.

ized ringer which is being used extensively for selectively signaling party lines. In this ringer the armature is biased, that is, held to one pole with a spring, as shown in Fig. 24. A pulsating current is used for ringing this bell. This current is explained in discussing the pulsating-current generator. A current ringing the bell is unidirectional and pulls the armature against the one-pole pole, while during the interval of no current the spring pulls the armature back. If the current is of the opposite polarity, the only effect will be to hold the armature tighter in its normal position. In order to make these bells absolutely mute when the current, which is not to ring them, passes through, the pivot should not have any end play at all; if it does have any play there will be a rattling sound. The adjustment should be such that the end of the armature rests against one pole of the magnet while the clapper does not quite touch the bell.

Usually four telephones are connected to one metallic circuit where these biased bells are used. Two bells are connected on each side of the line and bridged to ground. In ringing these bells a positive pulsating current is sent out over one side of the line, which passes through the two bells on that side and to ground. As the two bells are connected opposite to each other, one will ring while the other does not. If a negative pulsating current be sent out over this same side the other bell, only, will ring. In like manner, the bells on the other side of the line will ring, giving four different selections. This system is very convenient for party lines, as nobody except the party desired is called, consequently there is no mis-

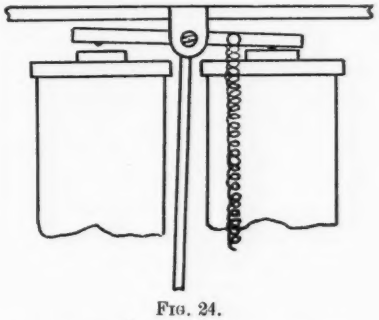


FIG. 24.

taking of signals and not so much eavesdropping.

By Cable—Around the World.

With the completion of the British cable from Vancouver to Australia a telegraph circuit now encircles the globe. On Saturday, November 1, Mr. Chas. J. Glidden, of Boston, Mass., sent the first telegraph message around the world. The message was started from the telegraph office of the Postal Telegraph and Cable Company in the Hotel Touraine at 9.15 A. M., addressed to Mr. Glidden, as follows:

Boston, November 1.

Glidden,
Boston, Mass., *via* Vancouver,
British Cable to Australia.
Around the World.

It was transmitted as any ordinary telegram, taking its place with the regular business of the several telegraph and cable companies, and was received in Boston by the Western Union Telegraph Company, at 12.35 A. M. Sunday, November 2, thirty-nine hours and twenty minutes after the message left Boston. Three minor errors occurred in the transmission and the message as received in Boston read as follows:

Southport (Australia), November 2.

Gleddon,
Boston, Mass.
Armund the World.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

A Method of Determining the Conductivity of Gases.

In this article Mr. F. Harms describes a new method of measuring the conductivity of gases. One difficulty met with in using Geitel and Wilson's method is that of determining accurately the capacity of the charged body. The author avoids this source of error by employing a body whose capacity can be easily calculated from its dimensions. This is in the form of a hollow brass sphere, suspended by a parafined glass fibre. Another error is due to a leakage of charge from the charging apparatus to the electrometer. A specially designed switch avoids this trouble. Voltages ranging from fifteen to seventy-one were used, and the results of the observations are given in tabular form. In conducting an experiment the body is charged and the current which will maintain this constant is noted. From this the quantity discharged by the sphere is determined. Assuming J. J. Thomson's figure for the charge of an ion, the results show that twenty-eight ions were created per second per cubic centimetre of the enclosing vessel. This had a capacity of 17,000 cubic centimetres. The radius of the sphere was 2.25 centimetres. The temperature at which the above experiment was made was eighteen degrees centigrade. When this was raised to twenty-five degrees thirty-three ions were given off. It is not yet certain that this increase was caused by the change in temperature, but the result was what might have been expected. Wilson's results gave fourteen and nineteen ions per second per cubic centimetre. The author checked his results by introducing into the centre of the sphere a wire made radio-active by exposure to the air after charging. This caused a more rapid discharge of the sphere for several hours; after this the normal conditions were recovered.—*Physikalische Zeitschrift* (Göttingen), October 1.

Prime-Movers and Their Ailments.

This is a summary of the annual report issued by Mr. M. Longridge, chief engineer of the Engine, Boiler, and Employers' Liability Company. The growing importance of the electric motor and oil and gas engines is exemplified by the fact that the space devoted to these is considerably greater than that dealing with accidents to the steam engine. In regard to the latter type of prime-mover, there is still a field open for improvement. Twenty-three per cent of last year's breakdowns to engines insured by this company arose from the negligence of owners or attendants. Another twenty-three per cent arose from bad design or workmanship. Thirty-one per cent are attributed to effects of wear and tear, and twenty-three per cent arose from accidents proper or causes unascertained. For gas and oil engines sixty-two per cent of the breakdowns are attributed to accidents from unascertained causes, twenty per cent to negligence, ten per cent to bad design or workmanship and eight per cent to wear and tear. Attention is called to the low range of stress under which crankshafts fail, and it is suggested that the elasticians are right in their contention that in every case in which the material gives way it does so under shearing stress. This failure may be attributed in many cases to the very small fillets used in pin construction. It should always be remembered that these pins are subjected to alternating stresses, and when this is true abrupt changes in section affect the safety of the bar. A frequent cause of accident in gas engines has been the formation of ice in the cylinders, and a great deal of difficulty has been met with in getting builders to fit draining cocks to the water-jackets. Another case of trouble in such motors is the lime deposited within the jacket. Motors and dynamos seem to suffer most from neglect on the part of the user, and until a breakdown has actually taken place it is impossible to persuade a proprietor to have such machines properly cared for. A case is mentioned where a three-phase motor, operating on a crane, was burned out under the starting load. Another similar accident occurred through neglect to provide a fuse for each of the three windings. Failures arising from the insulation of armature coils being worn through by rubbing are noted. In one case this seems to have arisen owing to the fastenings of the coils being unable to withstand the inertia forces resulting from changes in the angular velocity of the engine driving the dynamo.—*Engineering* (London), October 17.

Electrothermic Manufacture of Steel.

This article by M. Charles Bertolus describes briefly the Kerrouse generating station in Morbihan, France, where power is generated for use in manufacturing steel directly from the ore by the Keller system. This station was originally designed for manufacturing calcium carbide. It uses a fall of about 550 horse-power. The equipment includes four vertical turbines of 135 horse-power each, coupled through belts to two alternators of 200 kilowatts capacity each, and to two exciters. The Keller system for making steel electrically is described in detail. The furnace building contains a battery of electric furnaces for making alloys, a furnace room for making electrodes, and the main furnaces for the manufacture of steel. Each furnace contains two sets of two vertical electrodes, placed side by side, and respectively connected to the poles of a dynamo. The operation is regulated for each furnace, according to the character of the product, by raising or lowering, as may be necessary, one or the other of the electrodes. The use of four electrodes makes the operation continuous and allows a larger furnace to be used, as it has been found impracticable to make electrodes larger than a certain size. In the Keller system two operations are performed. The ore is first smelted, and the molten metal run out from the reducing furnace to a second furnace, where it is treated and reduced to steel. It was found impossible to produce a finished product in one furnace. The smelting furnace is not dissimilar from an ordinary blast furnace. The ore and carbon are charged in at the top, the large electrodes of carbon are arranged at opposite sides, and the heavy currents pass between these. This heats first the lower layer of ore and coke, and this finally ignites and the gases given off are burned. The ore is thus reduced, and finally the

molten cast iron collects on the hearth of the furnace. When this has reached a sufficient quantity, it is run out into a second furnace, and here it is subjected to a heavy electric current which reduces the cast iron to steel. The operation can be stopped at any time, as may be determined by testing the material, so that any quality of steel can be produced. This arrangement makes the whole process continuous. The following are the costs for material and energy at this point: Ore, delivered, ten francs a ton; coke, delivered, forty francs per ton; price of flux, fifteen francs per ton; price of labor per day, three francs; cost of electrodes per 100 kilogrammes, thirty francs; cost of the energy per kilowatt-year of 8,400 hours, fifty francs. At these figures the cost per ton of steel is approximately 100 francs. The quality of the steel obtained has been determined by careful tests, and has been found to be equal to that prepared in the usual way.—*Journal de l'Electrolyse* (Paris), September 1.

The Canadian Power Company's Development.

The Canadian Power Company's plant, which will be located on the Canadian side of Niagara Falls, shows considerable progress in the construction of its hydraulic works. Work was begun in September, 1901. The tunnel which carries the waste water from the wheel to below the falls is 2,200 feet long, and when finished will be twenty-five feet high and nineteen feet wide inside. It is lined throughout with seventeen inches of brick and concrete, except for 100 feet at the portal, where the lining will be of granite. The lower end of the tunnel describes a curve 700 feet long and emerges below the falls at Table Rock. The feeder canal will be 300 feet long and 280 feet wide, with a depth of thirteen feet at low water. The canal is faced with stone-cut masonry, as are also the wheel-pit, inlet and sluiceway walls. The construction of these works threatened to affect the intake for the Niagara Falls Park and River Railway Company's plant, so that it became necessary to build out a new river front, thus ensuring this power-house its full supply of water. The penstocks leading down to the turbine will be ten feet in diameter, made of steel, except the lower elbow, which will be built up of castings. The wheel-pit, when completed, will be 570 feet long, 160 feet deep, and eighteen feet wide, inside measurements. The part now under construction has reached a depth of ninety feet below the surface. The power-house will be of stone, 60 feet wide and 700 feet long, and will include all the offices. Two electric cranes of fifty tons capacity each will be provided. The first installation of machinery will consist of five 10,000-horse-power turbines, with generators of equal capacity. These will generate a pressure directly of 11,000 volts, which will be transmitted to a transformer house on the hill about half a mile away. The transformer house will be equipped with twelve transformers of 1,250 kilowatts each, which are being built by the Canadian General Electric Company. From here the current will be transmitted at 60,000 volts to Toronto and other Canadian cities. The generators are now being built by the General Electric Company, Schenectady, N. Y., and are of the inner revolving field type, three-phase, twenty-five cycles, 250 revolutions per minute. The turbines were designed by Escher, Wyss & Company, of Zurich, Switzerland, and are of the twin vertical Francis type, having an inward discharge. The weight of all moving parts will be carried by a water-balancing piston. There will be a thrust bearing at the upper decks. Each turbine will operate under an effective head of 136 feet, and will use 885 cubic feet of water per minute. The shafting will be of welded steel and hollow, except at the decks, where it will be of solid nickeled steel. The solid part will be fifteen and one-half inches in diameter, and the hollow parts three feet four inches in diameter. It is thought that these works will be ready to transmit power within eighteen months from date.—*Canadian Engineer,* November.

The Wireless Telegraph Expedition of the Italian Cruiser Carlo Alberto.

The Italian cruiser Carlo Alberto was assigned to Mr. William Marconi last summer by the King of Italy for exhaustive tests in wireless telegraphy. The vessel left Naples on the tenth of June, and sailed from there to England, where Mr. Marconi was taken on board. During the voyage, the apparatus for transmitting and receiving signals by the Marconi system was installed, and a long series of tests was conducted between the vessel and the Marconi station at Poldhu, England. The apparatus was then reduced to that of a simple receiving station, including two Marconi receivers, with coherers of metallic powder, and a Morse recorder. Three of Marconi's new magnetic detectors were connected with a telephone and arranged as indicated in his paper describing this new instrument. Aerial wires of the transmitting station consisted of four cables, suitably insulated, from which 100 thin, bare copper wires of tinned copper were suspended. The towers supporting this system were seventy metres high and sixty metres apart. The potential to which the network was charged was sufficient to produce a spark thirty-seven centimetres long between one of the conductors and a copper wire put to earth. Messages were sent from the station at fixed periods during the day and night. The vessel left England on July 7, and sailed for Denmark. Communication was kept up throughout the voyage, but those received during the daytime were not as well defined as those received at night. These messages were transmitted across the whole of England and over the North Sea, a distance of 900 kilometres. The vessel then passed around the north of Denmark and into the Baltic Sea. On the nights of July 10 and 11 messages were received with certainty, although they passed not only across England, but across Denmark and the southern part of Scandinavia. On the night of July 12, while the vessel was at anchor at Kronstadt, signals were received in the telephone, but these were rather feeble. To reenforce the signals a network of wires of thin, light and flexible tinned copper was suspended between the masts of the vessel. With this receiving system a series of "s's" transmitted from Cornwall were heard in the telephone. The vessel then sailed for Kiel, receiving messages every night. Some difficulty was encountered, due to atmospheric discharges, but it was found that a suitable shunt circuit could be arranged to exclude this disturbance. While at Kiel, messages were received at night continually and accurately, both by the detector and the coherer. The vessel then passed through the Kaiser Wilhelm Canal and sailed back to England, and thence to Gibraltar. On this voyage it was found that the maximum distance at which signals failed in daytime was about 1,000 kilometres. This applies to the energy then employed at the transmitting station of Poldhu. After reaching Caglairi, on the southern coast of Sicily, three historic telegrams were received from England. These messages were as perfectly written on the tape of the Morse machine as if the vessel had been connected by wire to the transmitting station. This voyage enabled Mr. Marconi to make careful studies of the effect of daylight upon the transmission of wireless messages. His explanation of this effect is based upon the photo-electric action of the sun in discharging negatively charged wires. This reduces the effective amplitude of the transmitter oscillations. The reduction seems to be proportionally greater the greater the amplitude, as it was not noticed especially with smaller amplitudes. Covering the wires with an insulating material was not found to be of any appreciable use.—*Electrician* (London), October 24.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

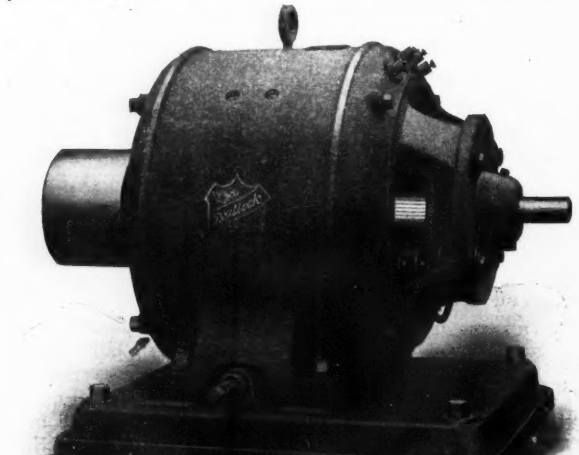
Direct-Current Machine Motors.

Each succeeding year the inroads of the electric motor are apparent in every line of industry. Mills and factories once operated by one or more steam plants are now operated by electric motors. The advantages are numerous. Much belting and shafting have been displaced and with it the expense of maintenance. The cleanliness of the electric drive is another feature that in many lines of industry is very important. The most valuable feature, however, comes from the increased output, due to the possible speeding up of the machines and the promptness with which they are started and stopped.

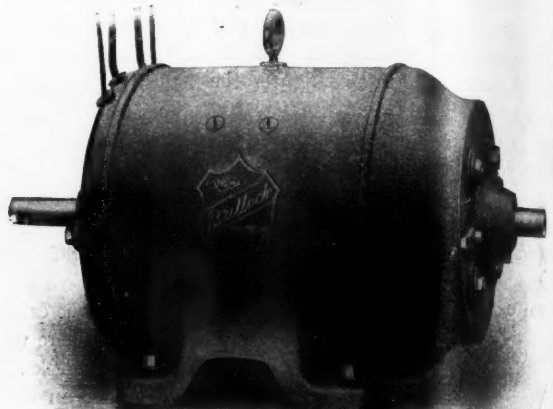
The machines here illustrated are made either open or enclosed, as desired. The enclosed motor is dust and moisture-proof, and well adapted to service in places where an open motor would be impracticable.

The details and construction of these machines have received the greatest care. The yoke is of cast steel, having laminated poles bolted into it. One advantage of this construction lies in the fact that the poles are accurately spaced and in perfect alignment with the armature.

The shape of the pole laminæ is such as to produce a slotted formation in the face of the pole. It also results in securing a saturated effect in the face and this, coupled with carefully proportioned windings, is largely responsible for the sparkless operation of these machines. With the brushes once set the machines may be operated in either direction without perceptible sparking. This is an important feature, particularly where motors must be frequently reversed, as in crane service or in the operation of metal-working machine tools.

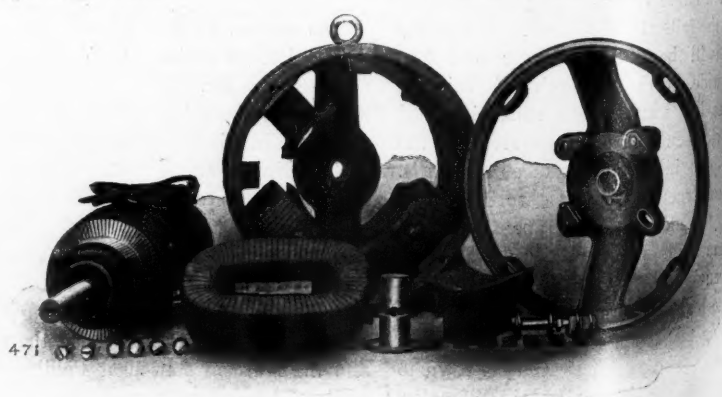


TWENTY-HORSE-POWER SEMI-ENCLOSED MOTOR.



THREE-HORSE-POWER DUST-PROOF MOTOR.

The field coils are machine wound, carefully insulated and mummified. They are slipped over the pole neck before bolting in the pole and held firmly in place by the pole horns. When the field current exceeds fifty amperes the shunt and series coils of compound-wound motors are separately wound.



FIFTEEN-HORSE-POWER MOTOR DISMANTLED.

The armature core is built up from thin, carefully annealed sheet steel possessing a high magnetic permeability. These discs are again annealed and then japanned and are mounted upon the shaft and held firmly together by malleable iron plates. When the machine is in operation a constant circulation of air is set up in the large ventilating ducts through the armature, resulting in cool running.

The windings, which are let into slots provided in the periphery of the armature coils, are made of either copper bar or wire, as best suits the requirements. The coils are machine formed, and after being formed are thoroughly insulated with mica and other high-grade insulators. They are then baked in steam-heated presses, which remove all moisture and produces a perfect and very compact coil. The result is a coil that is claimed to make injury almost impossible and one which requires no further insulation when placed in position on the core. The coils of armatures of large machines are held in position by

wedges of hard, thoroughly dried wood, driven into notches provided near the top of the slots. The smaller armatures are banded.

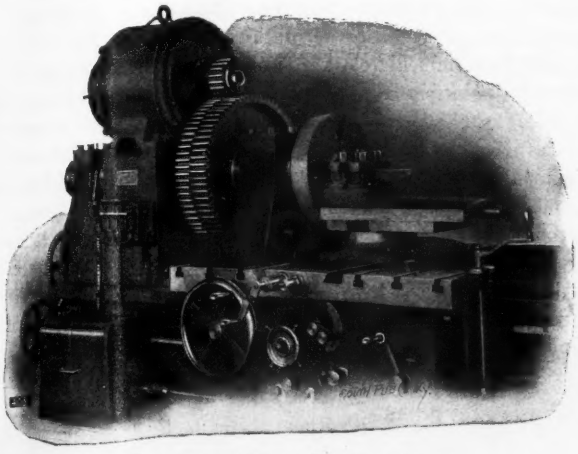
The bars of the commutator are made from pure, cold rolled copper. Each bar is an exact duplicate of every other bar in machines of the same size and voltage. There is seldom any trouble with the commutator owing to the great care used in its construction. The mica insulation is made under the company's supervision from carefully selected stock and wears uniformly with the copper.

The brush-holder is simple and highly efficient, giving absolutely no trouble. It is of the reaction type; no adjustment of the brushes is necessary, and when they are once set the motor will operate in either direction without sparking and under all variations of load.

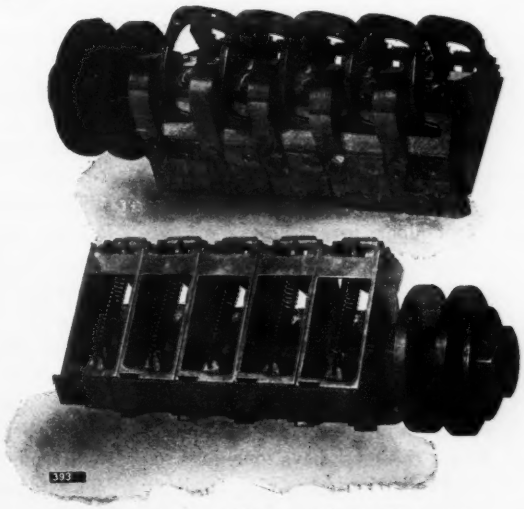
During construction these machines are subjected to rigid tests and a series of careful inspections, and when completed are run for a period of ten hours under full load. Every machine must fully comply with the specifications under which it is sold before shipment is made. The design of this type of motor lends itself to the conditions obtaining in direct-driven machinery. The machines are compact and made with either open or closed ends, the latter rendering the motor moisture and dust-proof, and adapts it to service where an open motor would be impracticable.

For places not usually dirty or damp the open type is recommended, for the reason that when ventilation is obstructed, as is necessarily the case in the closed type, the capacity of the motor is reduced by reason of heating limitations. It will be readily understood, therefore, that a closed motor for a service where power is constant would necessarily be of a larger size than an open motor for the same service. This is not true, however, for intermittent power service, such as for cranes, elevators, rolling mills, etc. Where the motor has an opportunity to cool between loads, a motor of the same dimensions as the open type being capable of readily handling the loads without being injured.

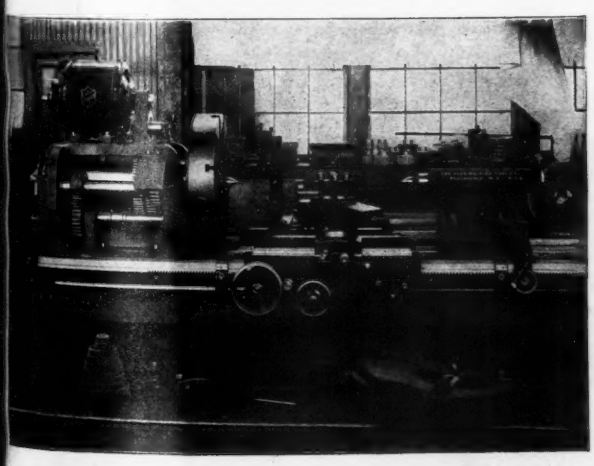
These motors are designated as type N, manufactured by the Bullock Electric Manufacturing Company, Cincinnati, Ohio.



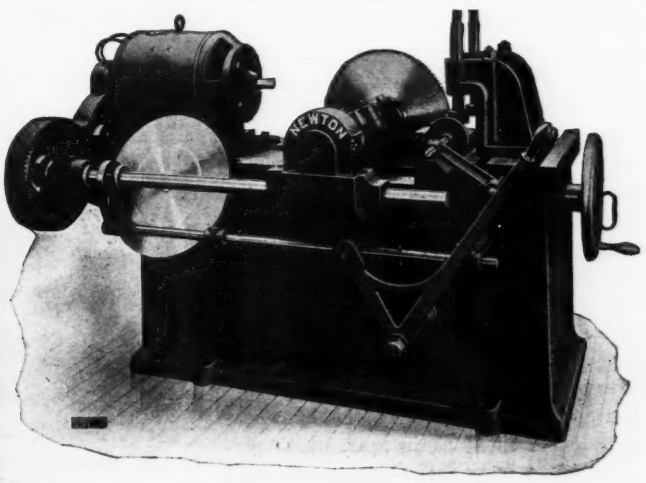
Motor Geared to Thirty-Six-Inch Lathe.



Front and Back View of Brush-Holder.



Thirty-Six-Inch Lathe Equipped with Motor.



Motor Geared to Cold Cutting Off Saw.

New Works for Manufacture of Engineering Specialties.

The Lunkenheimer Company, of Cincinnati, Ohio, manufacturer of brass and iron goods and specialties for engines, boilers, etc., such as brass and iron valves, whistles, injectors, lubricators, oil and grease cups, etc., on Saturday, October 25, formally opened its new works to about 3,000 visitors and friends and is now moving from the old quarters on Eighth street.

The buildings, of which there are five, represent an investment of over $300,000, consisting of the main building occupied by the brass department, with adjoining buildings for the iron department, brass foundry, power building and office building; all are of pressed brick and steel construction of modern type. They occupy about three acres of ground and have switching facilities; three acres additional ground provide for future extension of the business.

These factories are located near Brighton Station, in a section of the city called

Fairmount, within two miles from the centre of the city. It has been the aim of the company to construct the "model" plant in this industry, and many new and interesting features are noticeable.

The main building, 130 by 180 feet, is of gallery style construction, with a centre area measuring 30 by 80 feet; is three stories high and built so that three more stories can be added without interfering with the operation of the business.

The elevators and iron staircases are arranged within the centre area. All buildings are designed for 300 pounds per square foot floor load. The roofs are glass and clay tiling of Ludowici interlocking type.

A novel feature in the main building is the heating system, inasmuch as the hot air travels through the fourteen large hollow columns, which support the floors around the area in the centre of the building. These columns have openings on each floor to distribute the air; the bases of the columns are connected with a huge fan by means of tunnels under the basement floor. By this construction the usual galvanized iron air pipes are done away with and adds greatly to the simplicity of the building.

The type of window used is a novel one, and has a blind arrangement that is of great advantage during summer weather. The foundry is equipped with modern appliances, such as overhead track system for carrying material, smelting furnaces burning crude oil and many pneumatic appliances such as are used in the latest foundry practice. The general distribution of power throughout the building is the latest. The source of energy is a 300-horse-power compound engine which drives a 240-kilowatt, three-phase, 220-volt, General Electric, alternating-current dynamo. The current is led off from a switchboard to the different parts of the buildings, where suitable motors (principally attached to the ceiling) are provided to drive the various lines of shafting. These motors are of the Westinghouse and General Electric induction type without commutators or brushes. The power from the motors to the shafts is transmitted through what is known as the Renold silent chain gear, which permits of a very compact arrangement without noise and friction, thus dispensing with leather belts.

The engine room is also provided with a large cross-compound, two-stage, Laidlaw-Dunn-Gordon air compressor, which supplies compressed air throughout shops and foundry for driving pneumatic tools, hoists, etc. The boilers are of Babcock & Wilcox pattern, with automatic stokers. The engine room, the floor of which is laid in mosaic tiling, is considered one of the handsomest in the country; the company manufacturing engine and boiler fittings aimed to have a power plant strictly up to date and of handsome appearance.

Bell telephones connect all departments to a central exchange which connects with the city lines, thus affording immediate communication from any point in the works.

The illumination is furnished by Nernst lamps. Owing to the arrangement of the lamps, the distribution of the light is absolutely even and without shadows. The lamps are so arranged that sufficient illumination is secured without providing each operator with an individual light.

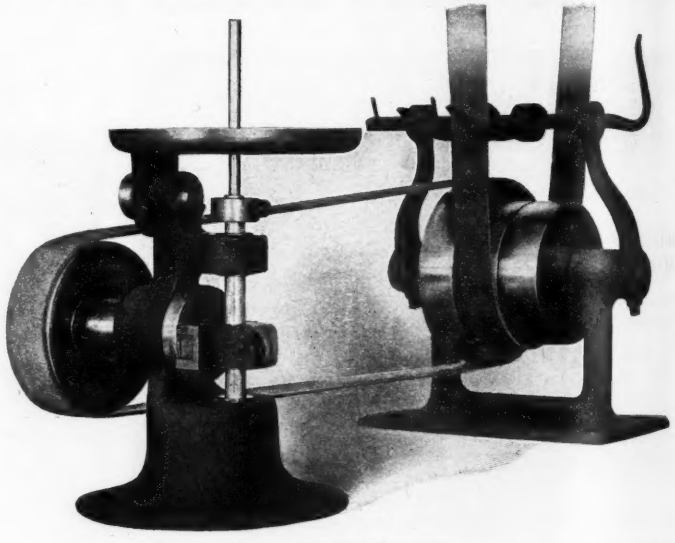
The office building is a three-story pressed brick structure, fifty by eighty feet, with modern equipment, the second floor being occupied by the drafting and engineering departments, the third, by advertising department, as well as a laboratory and photograph gallery.

The business was founded in 1862 by the late Frederick Lunkenheimer, and has grown to large proportions, now employing over 700 men. With increased facilities the company expects to extend its line and take up many new engineering specialties.

A Bench Filing Machine.

The accompanying illustration shows a mechanical appliance which has been placed on the market and which finds a very great use in almost every machine shop. This machine is claimed to be as much a labor-saver and improvement over hand filing as is the sewing machine over hand-sewing. Nine-tenths of the filing can be done by a machine like this instead of by the old, tedious hand-filing and in a fraction of the time spent in that manner. The machine occupies a space of six inches by six inches and may be placed on a bench alongside of any workman so that his filing can be done with the least loss of time. The speed of the machine is 800 revolutions, giving the files 1,600 strokes per minute, which shows at once the greater rapidity with which work can be done than with the manual operation. As each stroke of the machine is mechanically exact it is claimed that the operator can not fail to get perfect angles and true flat surfaces, there being no tendency to round the edges as in hand-work. This is a very important feature in die-work. The file travels vertically and is fitted to the spindle by a set screw and collar, and the table may be adjusted to the file at any angle.

This machine is placed upon the market by the Kinsey-Burt Company, 136 Liberty street, New York city.



Bench Filing Machine.

The Manufacture of Incandescent Lamps.

The Rooney-Westbury Electric Lamp Company, of 154 East Twenty-third street, New York city, has been incorporated to manufacture all kinds of miniature incandescent lamps and accessories.

The use of these lamps in the last ten years has grown to very large proportions and a steadily increasing demand is apparent. These lamps are used for decorative purpose, for advertising in store windows, for lighting displays and for use in candelabra and wall brackets. These are also designed that they are used very extensively in multiple and series work.

Another type of miniature lamp is that used in telephone switchboard practice and annunciator systems for visual signaling. Still another type of lamp is that used in surgical and dental instruments, and this use of the electric lamp is becoming very popular. It is claimed that at the present time there are 7,000 varieties of miniature lamps, and, as the field of usefulness of this class of lighting increases, a wider variation is very probable.

The manufacture of miniature lamps is one requiring very great care and attention, and while the large standard lamp is now more or less an automatic process—automatic machinery entering very largely into the building up of the apparatus—the miniature lamp is almost entirely a hand-made product, demanding expert labor and great skill in glass blowing, etc. Miniature lamps are now made as small as one-eighth of an inch in diameter, which will actually burn and give a brilliant white light.

The Rooney-Westbury company is placing on the market a number of novelties in the manufacture of miniature lamps. One is a double-filament battery lamp, so arranged that it can be burned with both filaments at once, or each filament singly, giving either of two grades of illumination. Another is a special form of miniature reflector lamp with a silvered bull's-eye, more than doubling the candle-power for the same expenditure of current. Several ingenious novelties in automobile lamps with reflectors are also among the new designs made by this company.

The president of the company, Mr. John Rooney, entered the electrical field in 1881, and was one of the organizers and president of the American Electric Light Company. He was one of the promoters of the Consolidated Electric Company and the Sawyer-Man Electric Company, all of which have subsequently been merged into the Westinghouse Electric and Manufacturing Company.

Mr. Harry Westbury, who is treasurer and sales manager of the company, is well known to electrical men generally. He was graduated from one of the largest colleges in the west of England, and has had considerable experience outside of the electrical field. On coming to the United States, he entered the employ of the General Electric Company, at Harrison, N. J., and was associated with Mr. W. H. Meadowcroft in developing and increasing the sales and uses of the miniature lamp; and after that gentleman resigned his position in 1899, conducted the commercial affairs of the above company until he recently resigned to enter the company with which he is now connected. Mr. Westbury is prominently identified with the developments in X-ray work, both in this country and Europe, and is an active member of the Rœntgen Ray Society.

MESSRS. ROONEY, MEADOWCROFT AND WESTBURY.

Mr. John J. Rooney, the general manager of the company, is a graduate of the Polytechnic Institute, of Brooklyn, and was one of the first students to take the electrical engineering course established in 1893 by Dr. Samuel Sheldon. Mr. Rooney has devoted himself to the study of many applications of electrical science and invention, and has done considerable research work in the storage battery field. He has also been very successful in the application of high-potential electrotherapeutic work, and recently installed a large plant for this purpose in London.

Mr. Francis J. Rooney, the secretary of the company, is a mechanical engineer and a graduate of the Polytechnic Institute, of Brooklyn. He was for several years assistant manager of a large manufacturing business in New York city, and subsequently the superintendent of an electrotherapeutic establishment, recently serving as private secretary to his father up to the organization of the present company.

Mr. William H. Meadowcroft, the vice-president, came to the United States from Manchester, England, in 1875. Mr. Meadowcroft entered the electrical field in May of 1881, when he became assistant and secretary to Major Eaton, then president of the Edison Electric Light Company. Mr. Meadowcroft continued his association with the Edison company and its successors over eighteen years, having been engaged in the various departments, two years having been spent in the legal department. During the last six and one-half years of his association with the General Electric Company, he devoted his entire time to the miniature and decorative lamp business, a branch of the lamp department which he originally started in 1885. Mr. Meadowcroft also took part in the development of the Rœntgen ray business of the General Electric Company from its commencement. He is possessed of an extensive acquaintance in the electrical field, and besides his active efforts in the practical work of the art, has contributed considerable literature to the study of electricity. In the summer of 1899 he left the General Electric Company to go in the storage battery business with Theodore Bardell and Frank A. Perret, when the Perret Storage Battery Company was organized. He has many financial interests in other corporations, and is treasurer of the Foreign Patents Company and of the American Stone Company.

In the Ural district, Russia, for 1901 was produced gold, 570 poods (2,052 pounds); platinum, 380 poods (1,368 pounds).

Annual Convention of the Electric Storage Battery Company.

The annual convention of the Electric Storage Battery Company was held in Philadelphia on October 13, 14, 15 and 16, the session being held at the Colonnade Hotel.

On Monday, October 12, the managers of the sales offices throughout the United States met at the factory and a tour through the works was made.

A luncheon was served at the factory, after which the staff of the battery company and the visiting managers of the sales department adjourned to the Colonnade Hotel, and after an address of welcome by the president, Mr. Herbert Lloyd, papers were read by Mr. Charles Blizard, manager of the sales department; Mr. Walter G. Henderson, secretary and treasurer, and Mr. A. B. Stoughton, general counsel of the company. In the evening a reception was held by the president at his residence, which was attended by the visiting members and officers of the company.

At the Tuesday session papers were read by engineers of the staff. On Tuesday evening a theatre party was given at the Chestnut Street Theatre.

On Wednesday papers were read by the different members of the staff. On Wednesday evening a banquet was given at the Germantown Cricket Club, Manheim, Philadelphia.

The banquet hall was almost completely filled by one large oval table, the surface of which was hidden beneath a mass of choicest cut flowers and beds of ferns. Three electric signs, reading, "The E. S. B. Co.," "1888"—"1902," were placed on the walls, and a menu card having for its cover a small facsimile of the company's price list, together with an embossed card bearing the Manheim Cricket Club's design and the guest's name, was at each plate. Between the various courses songs were rendered, and telegraphic despatches from Siam, Afghanistan, Turkey and the Sandwich Islands were received on a special wire. Brief addresses by the president, vice-president, secretary and manager of the sales department were made.

Meetings were continued on Thursday until noon, when the convention ended.

These annual conventions of the staff of the Electric Storage Battery Company are not only most enjoyable in bringing together the different sales managers and the corps of engineers stationed throughout the United States, but have been found to be thoroughly instructive, and it is a feature that is looked forward to annually with growing interest, bringing in touch, as it does, the representatives and enabling them to discuss the numerous problems which are met with in their work in different localities.

No small measure of the successful growth of the Electric Storage Battery Company can be attributed to the loyalty and earnestness of the staff, in its several fields of work and its devotion to the company's interests.

A graceful tribute of personal appreciation by his corps was made to Mr. Charles Blizard, manager of the sales department, in the presentation to him of a handsome watch.

MANAGERS OF SALES IN CONVENTION, COLONNADE HOTEL, PHILADELPHIA, PA.

To solder a piece of carbon and a piece of brass together, copper the carbon with a battery, then attach the brass with soft solder.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

RAPID TELEGRAPHY—It has been announced that further improvements have been made in a system of rapid telegraphy, whereby telegrams are now transmitted from Pressburg to Budapest over one wire at the rate of 50,000 to 70,000 words an hour. A Vienna newspaper describes a despatch which it received by this process. This consisted of a strip of stiff parchment, like paper, bearing 230 words. There was an ordinary dash between the words, which were easily read. The message occupied fifteen seconds in transmission.

LARGE TROLLEY MERGER IN CALIFORNIA—The largest trust deed ever filed in Los Angeles is that of the Edison Light Company, of Evanston, Wyo., and Los Angeles, to the Los Angeles Trust Company and the United States Mortgage and Trust Company, of New York, for $10,000,000. It is proposed to issue 10,000 $1,000 five per cent bonds, maturing in twenty years. Among the property included is the electric railroad line sixty miles in length between Los Angeles and Santa Ana, and other electric lines in nearly every county south of the Tehachapi Mountains.

WESTERN UNION WINS MILLIONS IN SUIT—A Federal Court decision by Judge Thayer, St. Paul, Minn., has recently added very much to the value of Western Union Telegraph Company stock. Ten years ago the Great Northern Railway Company began suit against the Western Union Telegraph Company to oust it from the right of way, and the case has been in court ever since. The line in question is 825 miles in length, and is valued at $2,500,000. The court holds that under the contract the Western Union company has a perpetual right of way, but that the railroad company is entitled to compensation for the transportation of material used in the construction of the line. The decision is of the utmost importance in view of the fact that the telegraph company has like contracts with all of the roads in the country. In touching on the attempt of the railroad company to oust the telegraph company, the court intimated that the action meant little less than confiscation. The opinion was concurred in by Judge Caldwell, and dissented to by Judge Sanborn.

THE WORK OF THE SIGNAL CORPS—The complete report of the operation of the Signal Corps in the fiscal year ending 1902 shows a very great increase in the number of telegraph lines established and the distances covered. As originally planned, the Alaskan telegraph system brought the territorial military posts in communication with each other. The line between Dawson and Fort Egbert has been completed, placing the American territory on the upper Yukon in direct communication with Skagway, so that telegrams can reach Washington in four days. The Canadian line between Dawson and Ashcroft has been completed, bringing the upper Yukon region of the United States in direct telegraphic communication with Washington and the commercial world. The completed lines connect Fort Egbert, at Eagle City, with Dawson; Fort Davis, near Nome City, with Fort St. Michael; Fort Liscum, at Valdes, on Prince William Sound, with Fort Egbert, over what is popularly known as the "all-American route to the Klondike;" Fort St. Michael with Fort Gibbon, at the mouth of the Tanana River, the military post at Skagway with Juneau, the capital of Alaska, and Fort Gibbon with Fort Egbert, *via* Rampart. During the year covered by the report, the system of telegraph lines and cables in the Philippines was increased by 262 miles. There are thirty-one submarine cables, 1,326 miles long, and land lines 5,108 miles long, making an aggregate of 6,434 miles. Three different types of automobiles have been tried for service in connection with telegraph trains and balloon trains—the electric, steam and internal combustion engine, respectively.

NEW EAST RIVER BRIDGE DAMAGED BY FIRE—Shortly after five o'clock on the evening of Monday, November 10, a fire broke out in the construction shanty on top of the Manhattan tower of the new East River Bridge connecting the boroughs of Manhattan and Brooklyn, New York city. There was considerable lumber stored on the top of the tower, and the building itself covered an area of twenty by eighty feet. Besides a considerable quantity of lumber, it is thought that a large amount of inflammable material used in the construction and for the protection of the cables was involved in the blaze. The extreme height at which the fire burned continuously for about four hours made it impossible for the firemen to get a stream of water of sufficient volume to materially check the progress of the flames. The temporary footpaths and false work which were constructed in order to enable the cable men to carry out their work were burned away from their supports early in the course of the fire, and a large portion of this fell into the river, blocking traffic for some time. The damage to false work and loss of tools and construction shanty, it is estimated, will be between $75,000 and $100,000. The damage to the cables is hard to estimate, but it is very probable that a great deal of repairs will have to be made on all but one, that furthest north, with the possibility of entirely repairing one section of the southernmost cable, which was the centre of the fiercest part of the fire. In all probability a great part of the steel work will also have to be removed and renewed, and a conservative police estimate places the damage at something like $50,000. The John A. Roebling's Sons Company, which had a contract for building the cables, had almost completed its work, and was now engaged on the last process of banding in the eighteen and one-quarter-inch supporting cables. It has been at work on these since August, 1901. The repairs which will be necessary to the structure will delay its completion for some time. It is understood that no insurance has been carried, and the loss will probably fall upon the contractors.

TELEPHONE AND TELEGRAPH.

MONTGOMERY, ALA.—The Western Union Telegraph Company has bought out the Alabama Midland Telegraph Company, whose lines reach from here to Thomasville, Ga., along the old Plant System Railroad.

NEW YORK, N. Y.—Plans have been filed for a fifteen-story brick office building for the New York Telephone Company. The building will be erected at 22 Cortlandt street, adjoining the present building. The cost will be about $500,000.

MARION, IND.—Articles of incorporation of the Home Telephone Company have been filed. This is the company which is to construct a line connecting Gas City, Jonesboro and Marion. The incorporators are: Elam H. Neal, Fred Schrader, C. H. Holston, N. G. Woodward and K. V. Haymaker.

NEW INCORPORATIONS.

VINELAND, N. J.—United Water and Light Company. $200,000. Incorporators: John B. Reynolds, Arthur A. Holbrook and Harry E. Sweeney.

TYLER, TEX.—Globe Telephone Company. $25,000. Incorporators: S. F. Richardson, C. C. Crews, J. T. Harris, J. R. Adams and J. B. Cave.

JERSEY CITY, N. J.—The United States Electric Company. $25,000. Incorporators: George C. Wilfong, Henry McDonough and Clarence Kelsey.

SOUTH BETHLEHEM, PA.—The Fountain Hill & West Bethlehem Light, Heat and Power Company; $1,000. The Consumers' Light, Heat and Power Company; $1,000.

GOWANDA, N. Y.—The Gowanda Telephone Company. $25,000. Directors: E. C. Fisher, Joseph M. Congdon, Robert E. Congdon, Glenn M. Congdon, William H. Britton, Jr., William A. Dietrich and William R. Smallwood.

ALBANY, N. Y.—The Protective Third-Rail Electric Rail and Block Signal Company. $500,000. Directors: Denis A. Kennelly, H. F. Clinton, Henry Lehman, A. M. Lowry and Frederick Brotherhood, all of New York city.

ELECTRIC RAILWAYS.

ONEIDA, N. Y.—The authorities of Kirkland have granted a franchise to the Oneida Railway Company for the construction of its lines through that town.

MONESSEN, PA.—The rights of way have been secured by the Webster, Monessen, Bellevernon & Fayette City Railway Company for almost the entire line, and the work will be pushed as fast as possible to completion.

ITHACA, N. Y.—The projectors of the new trolley line which will extend from Ithaca to Auburn held a meeting recently at Auburn, and it was decided to begin the work of surveying the route at once. The road will be forty miles in length.

MORGANTOWN, W. VA.—Orders have been placed by the Morgantown Electric and Traction Company for the machinery and rails for the road, and plans will be prepared at once for a $100,000 power plant. The road must be in operation by March 24.

MEMPHIS, TENN.—The Gulf Shore Electric Railroad Company has been incorporated, and will build an electric line from Henderson's Point, on Bay St. Louis, to Point Cadet, the eastern shore point of Biloxi. It will be twenty miles in length and will pass Beauvoir.

DENISON, TEX.—The Lehigh Traction Company, which intends to build an electric road from Atoka to Coalgate, I. T., has floated its bonds and now has all its funds ready to commence work. The line will be fifteen miles long, and will be completed within twelve months.

YORK, PA.—The charter for the extension of the York County Traction Company's new electric railway lines that will soon connect York with Harrisburg, has been filed with the county recorder. The proposed extension will take in Rossville, Newberrytown, Gildsboro, York Haven, Dillsburg and Bowmansdale.

ELMIRA, N. Y.—The contract for the construction of the Elmira-Waverly trolley has been signed, and work, it is stated, will begin before cold weather. The construction company takes over the issue of $400,000 in bonds in payment for its work, and the road will, with ten large cars, cost about $350,000.

UTICA, N. Y.—Initial steps have been taken for the construction of a trolley line from Rome to Boonville. Beginning at Rome, the proposed line would run to Westernville, North Western, Dunn Brook, Boonville, Talcottville, Martinsburg and Lowville. There is a possibility that engineers may be placed on the route this fall.

WATERLOO, N. Y.—It is stated that the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company has passed into the hands of another company, and that before next summer direct connection will be made to Auburn and Syracuse, with a possible extension of the line to Sodus. Philadelphia capitalists are the new owners.

WILMINGTON, DEL.—The charter of the Delaware Suburban Railway Company, with a capital of $100,000, has been filed. The company proposes to construct a road connecting with that of the Wilmington City Railway's extension at Stanton. The road will extend from there to Chesapeake City, through Newark, Elkton and other towns.

COLUMBUS, OHIO—The Southern Fast Line Railway Company has been incorporated by the following gentlemen: C. R. Grant, Thomas L. Childs, Charles H. Wheeler, George W. Sieber and Robert Herzer. The proposed route is stated in the articles of incorporation to be from Cleveland to Akron and Massillon, with the right to construct a branch to some point between Akron and Massillon to Canton.

ALBANY, N. Y.—The Brockport, Niagara & Rochester Railway Company has been incorporated with a capital of $500,000, to construct and operate an electric road forty-four miles long in Monroe and Orleans counties. The incorporators are: Frederick Beck, of Brockport; William Shields, of Waterville; S. J. Spencer, J. L. Bock and Stephen J. O'Gorman, of Buffalo; John Helling, of Rochester; Samuel W. Smith, of Holley; G. L. Smith, of Glade Run, Pa. The terminal of the road will be Rochester and Medina.

CINCINNATI, OHIO—The Norwood, Oakley, Madisonville & Red Bank Traction Company has been organized with a capital of $100,000, to construct a line from Norwood to connect with the Cincinnati & Norwood and the rapid transit route at Oakley, and with the Cincinnati & Oakley route. It is designed to cross the Madisonville line, and at Red Bank will connect with the East End route and the several Milford lines being projected. The incorporators are: David Davis, Peter Eichels, L. M. Strafer, Benjamin W. Harrison and A. E. Carr.

PERSONAL MENTION.

HON. CHARLES A. MOORE, of Manning, Maxwell & Moore, New York, will sail for Europe November 18, to spend the winter with his family in the Old World.

MR. J. F. COLE, of the Stanley Electric Manufacturing Company, Pittsfield, whose local offices are in New York city, has returned from an extensive trip abroad.

MR. R. T. LOZIER has been elected to the managership in the American Institute of Electrical Engineers left vacant by the election of Mr. C. F. Scott to the presidency.

MR. J. W. YOUNG, secretary of the Allis-Chalmers Company, whose New York offices are in the Broad Exchange Building, is to leave shortly for England, to assume the managership of the company's London office. He will be succeeded in the United States by third Vice-President Seaman.

MR. C. A. SANDERS, secretary of the Marshall-Sanders Company, has just returned from a Canadian trip. Mr. Sanders visited all the chief Canadian cities and spent some time in Montreal. He was kept very busy during his stay in Canada and could have made use of more time had opportunity been afforded.

MR. F. L. MARTIN, who so successfully handled the advertising of the Kellogg Switchboard and Supply Company for the past year and a half, has severed his connection with that company and has assumed charge of the advertising for the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., and Chicago, Ill.

MR. GEORGE F. PORTER, who was for ten years secretary and treasurer of the National Electric Light Association, has accepted the office of manager of sales for the Atlantic Insulated Wire and Cable Company, of Stamford, Ct. Mr. Porter's headquarters will be at 120 Liberty street, New York city. Mr. Porter had been associated with Mr. W. R. Brixey, manufacturer of Kerite wires and cables, for the past two years.

PROFESSOR SIDNEY HOWE SHORT, who died recently in London, England, was buried at Woodlawn Cemetery, Tuesday, November 11. Services were held in the Church of the Messiah, East Thirty-fourth street and Park avenue. The special train which was provided for friends to accompany the family to the cemetery left the Grand Central Station about 3.45 P. M., returning after the body had been placed in the receiving vault at Woodlawn.

MR. W. H. STOCKS, who has been master mechanic of the Chicago, Rock Island & Pacific Railroad for several years, has resigned from that company to accept an appointment as representative of the Gold Car Heating and Lighting Company, New York, Chicago and London. Mr. Stocks has been associated with the mechanical department of the Minneapolis & St. Louis Railway, the Great Northern Railway and the Chicago, Rock Island & Pacific Railway for twenty-five years, during which time he has worked in almost every capacity.

MR. W. P. McKENZIE, formerly manager of the New York office of the Harrisburg Foundry and Machine Works, Harrisburg, Pa., has entered into a copartnership with Mr. A. B. Quarrier. The copartnership will act as exclusive agents for the Harrisburg company in New York state as far west as Rochester and Olean, and in New Jersey as far south as Trenton, and also in the state of Connecticut. The name of the new firm will be McKenzie & Quarrier and in addition to the Harrisburg company it will look after the interest of several other engineering concerns.

ELECTRICAL SECURITIES.

While the results of the late election are undoubtedly looked at with great satisfaction by the majority of influences in financial circles, the outcome has failed entirely to buoy up the decline which set in several weeks ago. The developments of the week have been largely favorable to the bear party, and this accounts for the success in forcing the general declines scored, with a greatly increased volume of long stock liquidation. The monetary situation developed further acuteness as a result of the advancing sterling market, with the prospect of early gold exports. At the same time, rates have not advanced above 6 per cent, and the ruling rate has been 5 per cent.

The statistics of the country's money circulation on November 1, as issued, show a total of $2,336,111,992, as against $2,275,686,551 on the previous October 1, and $2,246,300,542 on November 1, 1901. As the population of November 1 was estimated as 79,572,000, the circulation per capita is $29.36. This is the largest figure ever recorded in this country, and larger than in any other nation. At the same time, so greatly has commercial and financial activity expanded in the prosperity of the past six years that it is claimed that even this enormous amount of cash capital is not sufficient for the business of the nation.

ELECTRICAL SECURITIES FOR THE WEEK ENDING NOVEMBER 8.

New York:	Closing.
Brooklyn Rapid Transit	60
Consolidated Gas	214
General Electric	180
Kings County Electric	205
Manhattan Elevated	134⅝
Metropolitan Street Railway	138½
New York & New Jersey Telephone	161
Westinghouse Manufacturing Company	212

With the single exception of Kings County Electric, all of the local securities of electrical interest made significant declines.

Boston:	Closing
American Telephone and Telegraph	163
Edison Electric Illuminating	265
Massachusetts Electric preferred	96
New England Telephone	138
Western Telephone & Telegraph preferred	98

It is stated that the gross earnings of the Boston Elevated increased about $40,000 over October, 1901.

The American Telephone and Telegraph Company's instrument statement for the month ended October 20 shows a total outstanding of 3,042,697 for 1902. For 1901 the number was 2,406,979, the year showing an increase of 635,718.

Philadelphia:	Closing.
Electric Company of America	9⅝
Electric Storage Battery common	87
Electric Storage Battery preferred	87
Philadelphia Electric	9
Union Traction	46¾
United Gas Improvement	113

Philadelphia, after holding firm under pressure for the week, dropped to 9 on the last day of the week.

Chicago:	Closing
Chicago Edison Light	107
Chicago Telephone	168
Metropolitan Elevated preferred	89
National Carbon common	30
National Carbon preferred	100
Union Traction common	18
Union Traction preferred	50

At the Metropolitan Elevated meeting, plans for the enlargement of the company's facilities were adopted unanimously. The company will commence to build new down-town terminals on January 1. Traffic thus far this month shows 20 per cent increase.

October, it is said, was the best month the Chicago Telephone Company ever had. The net increase is 2,940 instruments, making a total in the city of about 58,000, or a gain of 29,000 since President Sabin commenced his campaign.

ELECTRIC LIGHTING.

SNOW HILL, MD.—The Snow Hill Electric Light Company will shortly enlarge its plant at this place.

SOUTH NORWALK, CT.—The city has voted to appropriate $20,000 for improvements to the municipal lighting plant.

LA GRANDE, ORE.—The La Grande Electric Light and Power Company has been sold to parties represented by the Citizens' National Bank, of Baker City.

JAMESTOWN, N. D.—The Jamestown Electric Light Company has been renamed the Western Electric Company, and the powers of the company have been increased.

PHILADELPHIA, PA.—Plans for the new heat and light plant of the University of Pennsylvania have been sent out. The building, which will be larger than the present one, will cost $500,000.

ATLANTIC CITY, N. J.—The Pennsylvania Railroad Company is contemplating making extensive improvements to its power-house at this place. The building will be enlarged and the capacity doubled.

BLACKFOOT, IDA.—George H. Holbrook, Robert Hayes and J. M. Berryman have incorporated the Blackfoot Light and Power Company, with a capital of $100,000. The company proposes erecting power and water plants at Blackfoot.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company has purchased land near Frankfort, and will erect a large power-house to supply power to the new line of trolleys to run from Frankfort to Bustleton, and to the surrounding towns.

MANNING, MICH.—The company recently formed to put in locks and utilize the power of Black River has completed the survey and all preliminary arrangements. It is expected that 25,000 horse-power will be developed, which will be used by various manufacturing concerns.

SARATOGA SPRINGS, N. Y.—A deed has been placed on file in the county clerk's office at Ballston, in which the Hudson River Electric Company conveys to the Hudson River Power Company its pole line and right of way from Spier Falls, in Moreau, to High Bridge, in Ballston, for $110,000.

BETHLEHEM, PA.—The Bath Heat, Light and Power Company has been chartered, for the purpose of supplying heat and light to Bath and the adjacent territory. The directors of the company are: Charles Shuman, John McIlhaney, William H. Seem, of Bath; J. A. Miller, Leslie C. Williams, W. M. Bennett, of Nazareth.

SAUGERTIES, N. Y.—The Saugerties Light, Heat and Power Company has been incorporated with a capital of $50,000, and directors as follows: H. B. Hord, R. C. McCormick, of New York city, and C. W. Eichels, Jr., of Ridgewood, N. J. The company will supply electric light and power to the village of Saugerties and vicinity.

AUBURN, N. Y.—A mortgage for $250,000 has been given by the Citizens' Light and Power Company to the Knickerbocker Trust Company, of New York city. This mortgage covers a lien on all of the company's property, franchises, rights, etc. Thousand dollar gold bonds, bearing interest at five per cent, will be issued. These become due in 1932.

NEWTON, N. J.—The Woodbourne Electric Light, Heat and Power Company has given a mortgage on its real estate and franchises to Theodore F. Margarum, trustee. This mortgage is given for the purpose of securing the issue of $15,000 in bonds, the money so raised to be applied in the exercise of the corporate rights and privileges of the company.

BALTIMORE, MD.—It is rumored that the Continental Trust Company has purchased from Mr. Harvey Welch, of Philadelphia, the control and franchises of the Susquehanna Power Company, south of the Conowingo Bridge in Hartford County. The price is said to be $500,000. It is also stated that the power company will be merged with the Susquehanna Electric Company.

MONTGOMERY, ALA.—The Merchants' Light and Power Company has completed its organization with a capital of $100,000, nearly all of which has been paid in. The officers are: C. G. Abercrombie, president; Alexander Rice, vice-president; H. C. Jones, secretary; F. S. Ball, treasurer. The new concern has made a contract with the Montgomery Street Railway Company to furnish its power for the next fifteen years. The contracts call for everything to be ready for operation January 15 next.

INDUSTRIAL ITEMS.

THE C. W. HUNT COMPANY, West New Brighton, N. Y., has received the highest award of merit—a gold medal—for the "Hunt conveyor" at the Dusseldorf Exhibition which has just closed.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, has just issued a list of testimonials giving extracts of letters received from users of Packard incandescent lamps. This will be sent to any one interested upon request. The company is disposing of a great many Adams-Bagnall arc lamps for store lighting. These lamps are claimed to be very efficient and attractive for this class of service.

THE WISCONSIN GRAPHITE COMPANY, Pittsburg, Pa., is a manufacturer of a number of graphite specialties in the form of graphite and mineral paints in paste and ready mixed forms and in flake graphite for lubricating purposes. The company is in possession of a great many testimonials as to the excellence of its product and will be pleased to forward complete information upon request.

THE H. P. CAMERON ELECTRICAL MANUFACTURING COMPANY has been incorporated under the laws of the state of New York. This company will move into a new factory which is being erected for its use in Ansonia, Ct., about the first of December. It intends to put in a complete line of new machinery for the manufacture of all kinds of commutators, armature coils and electrical supplies in general.

THE UNITED STATES COAL COMPANY is about to equip its coal mines at Dillonvale, Jefferson County, Ohio, with electrical machinery, and for this purpose recently purchased from the Westinghouse Electric and Manufacturing Company two 150-kilowatt, 530-volt, direct-current generators, and two 10-ton mining locomotives. Electric power will be used for the operation of the locomotives and other mining machinery.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, is an exponent of the proper distribution of useful light. A publication has just been issued from the printing department of this company which is replete with useful and interesting information with regard to the proper rating and service of incandescent lamps. The context of the discussion is of a popular nature and will be easily understood by the untechnical reader.

THE UNITED STATES BATTERY COMPANY has removed from State street, Brooklyn, to New Rochelle, N. Y. This change is made in order to take advantage of enlarged quarters and improved facilities. The constantly increasing business of the company had made this imperative and it is expected that prompt attention can be given to the business now controlled by the company and that which is anticipated in the future.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, manufacturer of telephone instruments and switchboards, is now well established in its commodious new factory. The first floor of the building is entirely occupied with private offices and the counting-rooms and the upper floors of the building used for manufacturing purposes, one floor being entirely given up to switchboards, and the other features of telephone manufacture are well departmentized.

THE SORENSEN MANUFACTURING COMPANY, Ravenna, Ohio, is a recently organized company for the manufacture of static machines and X-ray apparatus. This company is said to have the largest factory of its kind in the world and that its apparatus is designed along the most scientific and accepted lines. In addition the company manufactures electrodes, X-ray tubes, fluoroscopes, barium-platino-cyanide, fluorescent screens, ozone apparatus, cathaphoretic instruments, etc.

THE PITTSBURG INSULATING COMPANY, Pittsburg, Pa., is engaged in the manufacture of insulating cloth and papers by the means of "Sterling" extra insulating varnish. The special process employed by this company enables it to furnish the trade with an absolutely uniform material, both in thickness and insulation. A large factory to further extend the growing business of the company is now being erected, and a plant is shortly expected whose combined capacity of insulating cloth and paper will amount to 20,000 yards a day.

THE E. W. BLISS COMPANY, Brooklyn, N. Y., manufacturer of presses, dies and special machinery, has purchased the plant and business of the United States Projectile Company, and is now prepared to furnish seamless steel forgings, such as bowls, collars, cylinders, etc. This company also manufactures the well-known "Projectile" brand of steel cut gears and pressed pinions for all systems of street railway motors. The projectile plant just acquired is over one-quarter of a mile in length and situated on New York Bay. It is equipped with all the modern tools and, having its own dock, is specially adapted for doing all kinds of heavy machine work, jobbing and marine repairs.

THE EUREKA ELECTRIC COMPANY, Chicago, Ill., is receiving a great number of enquiries with regard to its switch hook—which is one of its latest developments—and also its new transmitter. This switch hook and transmitter have special features which eliminate some of the difficulties which are claimed to be inherent in many types of apparatus. The transmitter does away entirely with the mica auxiliary diaphragm, and it is claimed that an equivalent result is achieved in a new and novel manner. This company is distributing a number of cards illustrating in colors different types of apparatus. These are very attractive and will be sent to any one interested upon request.

THE STUART-HOWLAND COMPANY, Boston, Mass., owing to the rapid growth of its business, has been compelled for the third time in eighteen months to materially increase its quarters. The latest addition includes the entire premises until recently occupied by the Pettingell-Andrews Company. This will give it about 30,000 square feet floor space and when remodeled, according to projected plans, will make a store and offices of very excellent facilities. The location, Devonshire street and Whitworth square, is in the heart of the busiest section of Boston, within easy access of street car lines from all the prominent points. This company started in business less than three years ago and its growth has been marked. The business is now one of the largest of its kind in the country.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has been awarded the contract for the apparatus for a municipal telephone system for St. Petersburg and Odessa, Russia. The St. Petersburg contract is said to be the largest ever awarded to any telephone manufacturer. The switchboard is of the two-division, lamp-signal, full common battery type, and will have an ultimate capacity of 40,000 lines, the present equipment being 12,000 telephones. The full equipment required by the Odessa proposition has not yet been learned, but the city has about 400,000 inhabitants, and this contract will undoubtedly be a very large one. All the apparatus is to be furnished of the latest Kellogg type, and the order has been secured in competition with many of the prominent manufacturers in Europe and the United States.

THE SHERWIN-WILLIAMS PAINT COMPANY, Cleveland, Ohio, is equipping all its works for electric power distribution. It recently purchased for its Cleveland works three alternating-current generators of 150-kilowatt, 120-kilowatt and 75-kilowatt capacity, respectively, and about 500 horse-power in induction motors, which will be used to drive all its paint and varnish-making machinery. The company has also equipped its Newark, N. J., works with one 75-kilowatt, alternating-current, engine-type generator and a number of motors and is about to install a duplicate plant at the same works. At Pullman, Ill., it is putting in a 120-kilowatt, alternating-current generator and one of 100-kilowatt, and about 200 horse-power in induction motors. The electrical apparatus for the several plants is being furnished by the Westinghouse Electric and Manufacturing Company.

THE RITTENHOUSE-MILLER COMPANY, Philadelphia, Pa., has recently placed the "Eureka" flexible conduit on the market. This conduit is manufactured exclusively by this company at its factory at Twelfth and Buttonwood streets. The company has recently removed its offices to 923 Witherspoon Building. "Eureka" flexible conduit is made of the best materials, and is said to be possessed of great flexibility. The interior is treated with a high grade of Italian talc, and ensures a great saving of labor in the installation of wires. The inner tubing will not absorb water and swell, and will not contract when exposed to high temperatures. The outer covering is a tough, fibrous material that is claimed to withstand all abrasion. It is treated with a fireproofing compound, thoroughly worked into the fibre, and the whole covered with an enamel baked on the conduit at a high temperature.